Case Study:
Site Conservation Plan
for the NC Sandhills

by

Lindy Nelson

A Masters Project submitted to the faculty
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of Regional Planning
in the Department of City and Regional Planning.

Chapel Hill, NC

2005

Approved by:

_____ _____

Reader (optional) Adviser

INTRODUCTION

Conservation planning is an approach by both non-profit conservation organizations and state and federal agencies in the US to frame problems and develop strategies to address the rapidly growing trend of species and habitat loss. In this case study, I take a look into of these planning efforts through the *Site Conservation Plan for the NC Sandhills*, a plan that I wrote based on the input of a group of hard working individuals who represent a broad range of interests. This plan was developed by the Sandhills Conservation Partnership, a network of state, federal and non-profit organizations seeking to protect biodiversity in the North Carolina Sandhills. Hired as a summer conservation intern, I worked to synthesize some of the previous work that had been done in the area by The Nature Conservancy, as well as organize two workshops to garner expert feedback on how to protect and enhance the biodiversity of the Sandhills. In this paper I seek to expose some of the inherent strengths and weaknesses of this effort, none of which necessarily belong to the individuals or organizations who participated in it. Many of the strengths and weaknesses are due to the institutional framework that conservation planning has evolved from, and some are due to quickly developing technology that holds both great promise as well as some false hope.

I attempt do this in the first part of the case study by laying out the institutional framework of conservation planning. I start by stating the problem of biodiversity loss and subsequent effects it may have on current and future human social and physical needs. Then, I examine the world of conservation planning – both its roots in the

American conservation ethic as well as to our relationship with our environment. This is followed by a look into the necessity for land use planning as a means to understand and address issues of biodiversity loss. The following chapter then explores a few types of conservation planning.

In the second part of the case study, I look directly at the Site Conservation Plan for the NC Sandhills. After a run through the background and impetus for conservation work in the Sandhills, I look at three aspects of the plan; (1) the process by which the plan was created, (2) the content of the plan and what it seeks to address, and (3) the outcomes that the plan seeks to initiate.

In the final part of the case study, I take a step back from the Sandhills example to see how it measures up to the ideals and previously mentioned types of conservation planning. By doing so, I hope to show the reader that, despite certain - perhaps inevitable - shortcomings of conservation planning, the effort pays off in both direct and indirect rewards. Ultimately, I hope the reader will come away with a better understanding of both the potentials and realities of conservation planning towards protecting biodiversity.

CHAPTER 1: PROBLEM DEFINITION – THE LOSS OF BIODIVERSITY

It is now widely accepted that we find ourselves in a phase of mass extinction that rivals those of the prehistoric past, where tens to hundreds of thousands of species were lost to unknown seismic events such as asteroids collisions or catastrophic climate change. There are now more species threatened with extinction in a shorter period of time than has ever been seen in earth's history. This extinction spans species of all kinds, from flora and fauna to insects and microbes. Unlike the extinction phases of the past, however, the threats behind the current extinctions are largely human in origin and look to magnify over the short-term rather than abate. This is due to factors such as: (1) increased demands for natural resources by a growing global human population and advances in technology that allow for greater change to the environment than ever before, (2) vast discrepancies in wealth distribution that orient poor countries, often located in species rich tropical regions, to disadvantageous resource extraction industries that destroy important habitat areas, and (3) complex stresses to ecosystems that combine to exponentially worsen ecological conditions (Primack, 1993). We have also discovered our dependence on the earth's resources and that the fate of human society lies in balancing our use of these resources with responsible stewardship and protection. The healthier and more plentiful that these living resources are, the more able we are to provide for the needs of our own kind.

The collective variability of living organisms, as well as their genetic and behavioral characteristics, is what is now called as "biodiversity". Genetic diversity is needed by a

species to maintain reproductive viability, resistance to disease and ability to adapt to changing environmental conditions. Species diversity is the range of variability in individual species, which are defined by biological and behavioral characteristics that differentiate them from other species. Community-level diversity is the interactions and relationships of spatial groupings of species, and their response to different environmental conditions. Together, these three types of living diversity compose what is referred to as biodiversity and are subject to different stresses and threats to their ability to maintain a viable long term existence (1993).

Many types of threat are cause to the current rash of extinctions. Habitat alteration is widely recognized as the primary cause of species population and ecosystem decline and extinction (Noss, 1997, p.5). Alteration takes three forms of negative effect: (1) habitat destruction (conversion of habitat to non-habitat), (2) habitat fragmentation (destruction of patches of habitat within large areas of habitat), or (3) habitat degradation (changes in the composition, structure or functions of an ecosystem). Biodiversity loss also occurs from the introduction of exotic species, which are relocated to new regions by human means and either out-compete native species for food and shelter or simply prey on indigenous species that are not adapted to the exotic predator. Exotic diseases, such as West Nile virus in the United States, can also damage indigenous populations of species that are not resistant to them. Overexploitation by fishing, hunting or harvesting has driven many species to extinction and threatens to continue to do so, as it has to ocean species such as right and bowhead whales (1993). These threats summarize the collective human activity that is not only reducing the world's qualitative and quantitative

biodiversity, but is also destroying many of the values this biodiversity has to offer the human species.

Biodiversity values can be seen in two categories – direct values and indirect values. Direct (or commodity) values can be assigned to products that are gained from consumptive use (consumed locally and do not appear in markets) and productive use (products harvested or developed from natural resources and sold in commercial markets). Biodiversity also has indirect values. Non-consumptive uses can be assessed from the services that biodiversity provides us by its mere existence and activity. These types of uses include ecosystem productivity, the protection of water resources, soil protection, recreation and tourism opportunities, regulation of the climate, waste disposal, species relationships and scientific value. Another indirect value is called option value, or the potential future benefits that might be discovered from a species existence such as a cure for a disease or potential food source. Others place value simply on the existence of biodiversity in its greatest form – what is referred to as existence, or intrinsic, value (1993). The many values biodiversity provides to human social and physical needs have recently been recognized by world leaders in an attempt to assess these values as "ecosystem services".

In March, 2005, a partnership of leaders in world organizations such as the United Nations, World Bank, World Conservation Union and leading universities science programs formed the Millenium Ecoystem Assessment Synthesis Report. This report brought together widespread input to address questions of how ecosystem change has

affected human well-being, and whether these ecosystem services can be enhanced through conservation. The report resulted in four major findings; (1) demands for fresh water, fuel, timber, fiber and fuel have driven biodiversity loss substantially and irreversibly, (2) changes made to ecosystems have produced substantial net gains to human well-being and economic development at the cost of poverty to certain cultural groups and substantially diminished benefits to future generations, (3) this degradation of future ecosystem services could grow substantially worse in the next 50 years, and (4) reversing these trends will require significant change to policies, institutions and practices in ways that reduce negative trade-offs or provide "positive synergies" with other ecosystem services (Millenium Assessment, 2005).

This growing global awareness of the importance of biodiversity and ecosystem services has been slow to catch on with American political and government institutions. In the following chapter I'll explore the roots of the American conservation ethic and resulting frame by which we address biodiversity in our country.

CHAPTER 2: JUSTIFICATIONS FOR BIODIVERSITY PRESERVATION

Despite the previous methods for valuing biodiversity, there are perhaps as many justifications for conservation of biodiversity as there are individuals who seek the aim. In the following section I'll present a few of the clearest voices on the subject that pertain to American planning and land management.

Aldo Leopold: When considering the conservation of biodiversity, I have yet to find a piece more timely, comprehensive and relevant than Aldo Leopold's seminal piece, *The Land Ethic*. In it, Leopold calls for the cultural development of what he sees as missing in the economic assessment of our decisions on how to use and value land – an ethic that places society's appreciation of "the land" (what he defines as soil, water, plants and animals) in its own dependence and relationship to the natural environment. He describes two ways to view the land: one way is to view it purely as a commodity that is bought, sold and used to maximize economic value that can be extracted, another way is to regard "the land as a biota, and its function as something broader (than a commodity)".

Leopold illustrates his argument for broader understanding in the context of the biological community through what he calls "the Land Pyramid". His land pyramid (which mirrors the ecological food chain concept) consists of soil, as the base of the pyramid, which lends rise to plants, which support insects that feed rodents and birds … a structure that builds up to top predators and humans. The complexity of this pyramid (or chain, if each relationship is considered a link) lies in the seemingly chaotic order of relationships and dependencies that each member of the community has to other

members. These relationships, or links, can be also represented as a complex circuit that fires on many different levels and operates best when the diversity of its members are represented to perform functions that relay the nutrients, energy or habitat (for example) that are required to continue the flow to other links in the chain or levels of the pyramid. The application of Leopold's concept would mean that, as members of the pyramid (chain or circuit), we make land use decisions that maximize the functions of the natural community, which also maximizes the benefit and stability to our position in the pyramid.

Perhaps the most startling aspect of Leopold's piece is how little has changed in the last sixty years in the hearts and minds of those who are most able to implement his ideal. He describes how "subterfuges" are invented to add value to members of an ecological community that otherwise would not be valued. Leopold uses the example of how diminishing bird populations in the early 20th century lead ornithologists to claim that insect populations would wreck havoc if not held in check by healthy songbird populations. Today, these techniques at adding value are continued as planners, environmentalists or land managers attempt to assess the economic value of ecosystems, develop market based policy alternatives and argue for the potential value lost in the genetic information of species and natural community as the pace of extinction quickens (see Daily 1988, Ehrenfeld 1976, Nabhan 1995).

While these efforts may be important for negotiating the field of politics and public approval, Leopold's main point is that land owners feel no obligation or responsibility to

behave in a manner that benefits the community when it comes to decisions that affect the natural community. When asked to consider the land ecologically, he states that the private landowner "assents only with outstretched palm". This behavior seems to be recognized today, as a glance at the newest policy tools for species protection or land conservation that are aimed at supplying incentives, or subsidies, to encourage the private landowners to manage their land with consideration to the biotic communities.

Leopold comes to another point that is interesting in the context of current planning and economic thought. Technology, he states, has brought about tools (i.e., the "steam shovel" of his day) that increase the ability to perform acts of greater "violence" to the land. He draws the conclusion that there is an inverse relationship between the level of violence performed and probability for a natural community to readjust to losses in the land pyramid. This violence is correlated to human population density, whereby greater density leads to more violent conversion. (A building footprint, for example, has done greater violence to the land than a plowed field and will yield a much less robust ecological community upon efforts to restore it.) He states that ecology "knows of no density relationship that holds for indefinitely wide limits. All gains from density are subject to the law of diminishing returns." When placed next to urban planning and economic development concepts of "New Urbanism" and "cluster development" as means of protecting elements of natural communities, his thoughts create a number of questions and potential conflicts that extend beyond the scope of this paper.

John Muir: The protection of "nature" has been called for perhaps most romantically through John Muir's descriptions of and struggles to protect the American forests and "wilderness" areas. Muir served to iconize the most ardent, unapologetic love and advocacy for saving nature as it existed. He spoke for the establishment of vast preserves and parks that protected forests in their own right, both for the beauty they brought to people and for their intrinsic value that was established through God's creative hand. In his essay, *The American Forests*, Muir states:

> It took more than three thousand years to make some of the trees in these Western woods, – trees that are still standing in perfect strength and beauty, waving and singing in the mighty forests of the Sierra. Through all that the wonderful, eventful centuries since Christ's time – and long before that – God has cared for these trees, saved them from drought, disease, avalanches, and a thousand straining, leveling tempests and floods; but he cannot save them from fools, – only Uncle Sam can do that (p.720).

In *The Mountains of California*, Muir describes his beloved Sierras with paternal love. From his description of the elevation range of Incense (Red) Cedar to the geologic processes of the Sierras to his sketch of a Douglas squirrel's track patterns on a pine tree, Muir takes his reader on a vivid trek through the California Mountains. His aim, I believe, is to attach the reader to the qualities of the land, both biotic and geologic. By doing so, the reader will be brought to understand the inherent value found in the characteristics of the many species that have survived in balance and continuity, before being threatened by the ravaging of ax and crosscut.

Edward (E.) O. Wilson: E.O. Wilson, one of the most well known ecologists of this generation, makes the case for the preservation of biodiversity in his treatise *Biophilia*. Whereas Muir and Leopold tie the value of non-human species to God and the Divine,

Wilson's argument is purely material. He develops a hypothesis, Biophilia, which he defines as "the innately emotional affiliation of human beings to other living organisms." Biophilia stems from genetic human evolutionary origins, whereby we have developed a complex behavior pattern of learning rules towards our natural environment that are manifest in our culture. These rules include the full range of emotions: "from attraction to aversion, from awe to indifference, from peacefulness to fear-driven anxiety." These behavior patterns lag behind the technological advances that propel our culture. Wilson argues that, as species blink out of existence at increasing rates, the meanings of their existence that have defined our bio-cultural evolution will immeasurably diminish our own humanity by definition alone.

Wilson gives four detailed justifications for the preservation of biodiversity:

1. *Biodiversity is the Creation* – the information (genetic, behavioral, etc.) of existing species, if lost, reduces the meanings found in our myths of origin.
2. *Other species are our kin* – humans have evolved from the same ancestral roots as existing plant and animal species 1.8 billion years ago.
3. *The biodiversity of a country is its natural heritage* – each country is home to distinct assemblages of species that define and create meaning to the national territory of a given country.
4. *Biodiversity is the frontier of the future* – the exploration of earth's biodiversity offers humanity a vision of the infinite. As 90% of the earth's species lack even a name, the frontier lies in learning and understanding how these species can add to our science, art and practical affairs.

Yi-fu Tuan: The humanist geographer, Yi-fu Tuan, ties our human experience as interwoven with a desire to interact with, as well as escape from, the elements of nature that I consider here in the context of biodiversity (a point I'll return to). In *Escapism* (2001), Tuan defines Nature (with a capital *N*) as "all there is" and "nature" (with a small *n*) as "that layer of the earth's surface and the air [and biota] above it that have been unaffected, or minimally affected by humans" – an objective attempt at defining that which is not culture. Tuan inadvertently calls to attention a problem that permeates the very core of biodiversity preservation – perhaps genetic diversity notwithstanding – the structure, relationships and interdependence of the earth's biota are construed in the context of our limited cultural understanding of our environment in the most general sense. The field of ecology's great strides towards understanding the forms, scales and processes of biological communities remains insufficient to form an objective view of our Natural environment. Therefore, we are limited to our understanding of the natural (small *n*) environment as a means to understand, protect and reconstruct ecological systems that we feel will preserve Nature in its fullest sense. In fact, Tuan might argue that our very attempt at protecting or "saving" biodiversity is our attempt to escape the very reality of our inescapable role in Nature.

In *Space and Place* (1977), Tuan asserts that humanity's "nostalgia for an idyllic past waxes strong" when change appears to cycle out of control in our cultural environment. He states that we seek to fill our environment with objects that support our sense of identity, and that a rationale for preservation is based on the aesthetic, moral or morale-

boosting. For example, using transferring Tuan's arguments to the North Carolina Sandhills might yield the following results:

- *Aesthetic* - The Longleaf pine aught to be saved as it is an ecosystem of distinction …
- *Moral* – The Sandhills Longleaf pine is a remnant patch of a once predominant forest that, before colonization, stretched from New Jersey to Florida, to Louisiana …
- *Morale Boosting* – Preservation of the Longleaf pine is to save the resource that build the ships of the early Navy …

In fact, Wilson's four justifications could fall neatly into the above categories. Tuan draws attention to another necessity of the natural world in *The Good Life* (1986) – that of added meaning by an appreciation of its authority. Tuan states:

> Most forms of organic life cannot resist our power. Yet if we choose to contemplate rather than exploit them, they too can make our lies feel less feverish by the calmness of their perduring rounds (p.83).

The above authors represent some of the keenest insights on our relationship to nature and, thus, our justification for protecting biodiversity. It seems that, regardless of our religious or philosophical perspective, when we seek to understand our place we find that we are indelibly tied to the natural world. When it exists in its fullest sense, we benefit all the more. This realization of nature's importance has lead to grassroots and government

reactions to try to stem the tide of biodiversity loss by planning for and regulating human use of the land. The next chapter will explore this reaction in greater depth.

CHAPTER 3: LAND USE PLANNING FOR BIODIVERSITY PROTECTION

Biodiversity protection and preservation takes place on several fronts. The Endangered Species Act (1973) acknowledges the rights of all species by lending legal protection to those that are recognized as in danger of extinction. Land managers working for government agencies and non-profits design and implement programs to benefit game species for hunters, or to enhance lands ranging from small scale habitats to park and reserve ecosystems for recreation purposes. Land Trusts and governments in fields related to the consideration of biodiversity acquire key pieces of land that are considered to be "prime" habitat and that benefit their organization's vision. Very rarely, municipal or county governments will also consider endangered species or habitat in the decision frameworks that are created to design future land uses.

Land use planning takes place in each of these circumstances, but its role and ability to protect biodiversity is often ad hoc and experimental. If done well, however, the hope of planners and environmentalists is that land use planning holds great promise to addressing the unspoken needs of other species and ecological systems at scales of appropriate measure. The literature in this field is growing exponentially with deepening understanding of implications behind species extinction and the advent and advancement of applications from Geographic Information Systems (GIS) technology to the field. In this chapter I look into the necessity for land use planning to protect biodiversity, and will touch on GIS applications in my closing discussion.

The Endangered Species Act

The Endangered Species Act, the legal foundation for American endangered species protection, is given a thoughtful overview in Daniels and Daniels (2003). They outline the main premise of the act as follows:

- The law applies to both public and private lands (key for protection efforts, as 70% of threatened and endangered species occur on private lands).
- The law prohibits the willful "taking" (killing, hunting, harming, capturing or collecting) of threatened or endangered species.
- Violations of the law range from $500 to $25,000, with up to 12 months in jail per infraction.
- Any citizen may file suit against an individual or organization for violations of the law.

The law is administered by the US Fish and Wildlife Service and National Marine Fisheries Service, charged with the responsibilities of identifying threatened and endangered species and their critical habitat areas, drafting and implementing recovery plans, reintroducing species into potential habitat areas and levying fines for infractions. Currently, 1078 animals and 749 plants are listed as threatened or endangered in the US (Threatened and Endangered Species System).

The Endangered Species Act, while a key component of endangered species protection, has been noted for at least two popular shortcomings. First, the law is designed to react to species that are already on the brink of extinction, as opposed to proactively serving to enhance species populations. Second, the act focuses on individual species and habitats,

as opposed to protecting and enhancing entire ecosystems (Daniels and Daniels, 2003). Despite these shortcomings, the law has empowered individuals and organizations to implement planning efforts around the country that are designed specifically to enhance or protect species, habitats, ecosystems or landscapes.

Two types of plans have been developed directly as a result of the Endangered Species Act. Recovery Plans focus directly on a given endangered species, with the goal of recovering the species to a stable population of genetically viable levels. Habitat Conservation Plans are written by private citizens, municipalities or multiple-party partnerships to receive an "incidental take" permit, an exception to the Endangered Species Act that allows citizens to take a number of endangered species if the taking is compensated by promoting the survival of the population or species in another way (1997, p.12). These types of plans will be revisited in the following section (*Example Biodiversity Protection Plans*), but demonstrate that the Endangered Species Act has direct implications on land use planning, as recovery efforts must focus on habitat at a small scale and ecosystems on a larger scale.

A Need for Land Use Planning

In his paper, *Preserving Biodiversity*, Timothy Beatley (2000) acknowledges the challenges of biodiversity protection and points to planners as the "lynchpin" in a more comprehensive conservation program. He states that planners must develop bolder strategies than the Endangered Species Act to preserve biodiversity in the face of the direct impacts of urbanization and land use changes. He points to strategies of long-range

land use planning that integrate large-scale ecological systems of connected green space and habitat, more ambitious conservation goals, checks on wasteful development patterns, regional approaches to multi-agency and organization lands, new approaches to funding acquisition of lands and incentives for conservation on private lands. Beatley calls for a new paradigm in conservation planning that redefines the role of cities and communities in biodiversity preservation and protection.

Kathrin Day Lassila (1999) points to sprawling suburban development as a cause of both habitat destruction and invasive species. The patterns of low-density residential growth that are typical rings of most American urban areas are responsible for much of this conversion of greenfield (undeveloped) sites to urban sites. In the last 50 years, urban land has quadrupled and 95% of species listed under the Endangered Species Act are thought to be endangered by habitat loss, fragmentation or other alteration. Invasive species are considered to be the second greatest threat (citation). Invasive species are generally well adapted to exist in human altered habitats and out-compete more sensitive species, such as the case of the invasive bullfrog decimating populations of yellowleg and the endangered redleg frogs in the Sonoma Mountains of California (Lassila, 1999). Sprawling urban development has been suggested to be a direct threat to the extinction of one out of three imperiled species over the next fifty years (Ewing et. al., 2005).

Beatley (2000) points to states with rapid growth as often holding the greatest numbers of endangered and threatened species, a phenomenon dubbed ecological “train wrecks” by former Secretary of Interior Bruce Babbit.

This fact is illustrated in Table 1 below:

State	Number of Threatened or Endangered Species*	State Rank: Threatened or Endangered Species*	State Growth Rank (Population Increase)**
Hawaii	317	1	35
California	298	2	1
Alabama	115	3	25
Florida	111	4	2
Texas	97	5	3
Tennessee	96	6	12

Table 1: Comparison of States by Endangered Species and Population Growth Rank (*Source: US Fish and Wildlife Threatened and Endangered Species System, **Source: US Census Bureau)

As a result, Beatley calls for certain semi-specific growth patterns, a point I will take indirect issue with in the *Discussion* section of this paper. He states that growth must take place in compact, urban form – presumably so greater areas of open space can be preserved. He also states that comprehensive land use policies must be crafted that protect essential habitat corridors and linkages (now potentially a dated thought in light of recent advances in ecology).

Of the biodiversity preservation policies generally implemented, land acquisition is the primary tool and aim of land trusts and conservation organizations. Beatley calls for not only for a more aggressive approach to acquisition of sensitive and important habitat lands, but also for implementation of a host of strategies. Such tools include: 1 – stricter growth restrictions on lands that are potential public safety hazards (due to potential natural hazard incidents), State legislation to allow Transfer of Development Rights for landowners and urban areas[1], market based strategies and incentives that encourage the protection of endangered species and habitats (2000).

[1] Transfer of Development Rights programs allow landowners situated in a designated "sending zone" to sell development rights to landowners or developers in a "receiving zone" with the aim of protecting rural natural or agricultural areas from being developed.

Beatley's most compelling argument is his stance on redefining the role of cities in addressing biodiversity loss. He states that planners should not lose sight that cities can be home to some complex ecological networks and are responsible for much of the degradation to the land's ecological quality. Beatley points to the Davis Wetlands Project as an example of a city taking proactive steps on wastewater treatment. In this project, the city partnered with a number of government agencies and UC Davis to create a linked network of wetlands that receive stormwater and treated wastewater. The wetlands now serve both as critical habitats for wetland species and migrating birds, as well as for natural purification for urban water flowing back into the Sacramento River. He calls for similar efforts to look to restore natural waterways, such as daylighting streams that have been channeled into culverts or covered up and desealing and deconstructing heavily built waterfronts that impede or diminish the ability for waterways to act as natural systems. Cities should act as examples in the marketplace when providing public services by requiring the use of, for example, sustainably harvested wood for public works and organic or sustainably harvested food for public schools – choices of products which educate the public while reducing the impacts down the production chain. Greater recognition of the impacts that urban areas have on adjacent as well as non-adjacent natural areas should lead to programs that increase the efficiency and responsibility of those areas such as the recycling of energy, waste materials and water (2000).

Former Secretary of the Interior, Bruce Babbit, points to scientists and government officials as responsible for initiating comprehensive, regional planning efforts that

incorporate biodiversity preservation into land use planning by what he dubs “urban bioplanning” (Babbit, 1999). Babbit brings up the example of explosive urban growth in southern California that was destroying the coastal sagebrush ecosystem, and home to the newly listed California Gnatcatcher. The potential conflict US Fish and Wildlife officials to gather a consortium of state officials, county supervisors, biologists, land-use planners and economists to build a consensus plan made up of a series of habitat conservation plans for 210,000 acres between San Diego and Los Angeles. Babbit states that the approach led to opportunities for mutual learning from representatives of differing interests and should be a model built on in other urban areas.

The above authors clearly define that land use planning is not only important, but is a critical component of our ability to preserve biodiversity. Urban sprawl and incompatible uses with sensitive habitats and ecosystems must be approached at a scale and scope that will accommodate human uses, while mitigating the harms to our natural environment.

CHAPTER 4: TYPES OF PLANS THAT ADDRESS BIODIVERSITY PRESERVATION

With the hope of drawing the greater body of biodiversity planning into this case study, I've assembled a few sources on different types of plans that address biodiversity preservation. By doing so, the Site Conservation Plan for the NC Sandhills can be viewed in the context of peer works to highlight its strengths and weaknesses in the case study process. This section is by no means a comprehensive outlook at the different styles of biodiversity plans, but it does allow the reader a glimpse at the wide range of approaches that are taken towards this endeavor.

The World Resources Institute, in cooperation with the World Conservation Union have developed ten guiding principles for biodiversity preservation planning, based on extensive international experiences with implementing national programs in developing countries (Miller and Lanou, 1995). These principles state that biodiversity plans and programs should:

1. Improve and maintain the well-being of people as well as the productivity and diversity of ecosystems
2. Contribute to larger goals of sustainable development
3. Select objectives that are few in number and, thus, achievable in a reasonable period of time
4. Include a process that is adaptive and cyclical
5. Involve multiple stakeholders in a participatory process

6. Be steeped in communication and negotiation as the "lifeblood of a biodiversity-planning process"
7. maintain an understanding that the success of planning lies in decision making and subsequent actions, not the plan itself
8. be incorporated into key institutional decision-making systems
9. build capacity for biodiversity planning in the earliest stages of the process for the long term
10. tap external (i.e., developed country, federal or state agencies) technical and financial assistance while allowing local coordination and leadership

These principles are interesting to keep in mind when perusing the different types of planning efforts that focus on biodiversity from different institutional frameworks and professional fields.

Species Recovery Plans – The US Fish and Wildlife is charged with the creation of Species Recovery Plans for each species that is listed as endangered or threatened according to the Endangered Species Act. Of 1078 listed threatened and endangered animals, 313 have recovery plans and of 749 listed plants, 615 have recovery plans (Threatened and Endangered Species System, 2005).

An appropriate example of species recovery plans is *The Red Cockaded Woodpecker Recovery Plan* (2003). This plan (as are all recovery plans) is written with the express goal of recovering the Red Cockaded Woodpecker (hereafter RCW) to stable population levels at which it will be delisted (removed from endangered or threatened status and

legal protections dropped). The plan is developed and written by a skilled team of agency and non-profit professionals who have direct or indirect expertise with the RCW. The plan includes the following elements: 1 – the reason for the RCW's population decline and rationale for its federal status as endangered, 2 – a comprehensive description of the general biology and ecology of the RCW, 3 – habitat management techniques for preserving RCW populations, 4 – current RCW status and related conservation initiatives on state, federal, private and tribal lands, 5 – the RCW recovery goal, 6 – detailed criteria for the delisting and downlisting (i.e., from endangered to threatened) of the RCW's status, 7 – management guidelines for recovering individual RCW populations, 8 – a schedule and cost outline for achieving RCW recovery. Recovery Plans such as this are detailed, comprehensive information resources on individual species, but are often criticized for focusing too narrowly on habitat and single species concerns without consideration of a broader array of factors.

Habitat Conservation Plans – The Endangered Species Act has not only received criticism regarding its reactionary nature and narrow focus but has even been considered potentially harmful to the species it seeks to protect when examples of new species listings lead private landowners to attempt to eradicate occurrences of the species in fear of lost rights (development or resource) to land holdings. Habitat Conservation Plans have served to alleviate some of this pressure by allowing landowners with endangered species occurrences to obtain "incidental take" permits after such a plan has been approved by the US Fish and Wildlife Service. Incidental take would allow the landowner to proceed with development plans, with the designated take compensated for

in some other way. Increasingly, these plans have developed from a focus on single species habitats less than 100 acres to Thus, these plans have been praised for reducing the contentious nature of endangered species listings. However, they are not without some criticism. The requirement for using "best available science" to define the criteria and the flexibility allowed to adjust criteria to site specific circumstances is considered to be both a strength as well as a weakness. The potential for abuse exists in its flexibility, and often "best available science" is simply not available, given that endangered species are often not biologically or ecologically well understood (Harding, et. al, 2001).

An example of habitat conservation plans, the East Contra Costa County Habitat Conservation Plan was initiated by East Contra Costa County at the bequest of the US Fish and Wildlife Service in 1998. The ongoing process was continued in 2001 after a consultant was found to begin data collection and habitat mapping. Rather than the traditional development of a single document, this plan was (and is) more of a process oriented methodology that involved the continued development of a series of documents to gain permit approvals and inventory natural areas, with the ultimate aim of a single habitat conservation plan document that balances inventoried resources with conservation plans and development permits. Such developmental documents include: 1 – a detailed spatial inventory of aquatic and terrestrial natural resources prepared by a small group of resource based scientists, 2 – a draft permit program for obtaining impact rights for development in the study area, 3 – a draft conservation strategy and alternatives document, and 4 – a schedule for the implementation agreement (East Contra Costa Habitat Conservation Plan Association, 2005).

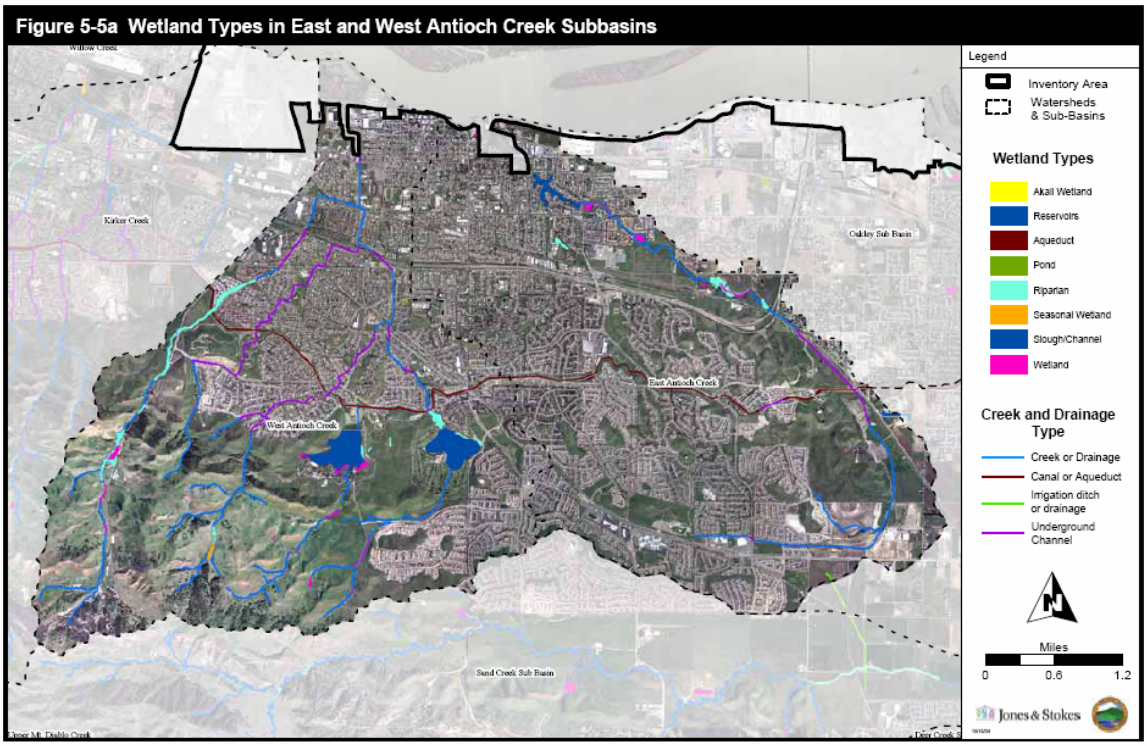


Figure 1. Sample of the Wetland Inventory Maps in the East Contra Costa Habitat Conservation Plan process (Source: East Contra Costa Habitat Conservation Plan Association, 2004).

Green Infrastructure Plans – Mark Benedict and Edward McMahon's (2001) define green infrastructure as "an interconnected network of greenspace that conserves natural ecosystem values and functions and provides associated benefits to human populations." Green Infrastructure Plans can be developed at a local to multi-jurisdictional level by public or non-profit organizations and focus on assembling networks of this green infrastructure as an integrated component with other forms of public infrastructure and development, such as roads, water, electric and zoning. Whereas Species Recovery Plans and Habitat Conservation Plans stem from the US Fish and Wildlife Service institutional framework, Green Infrastructure Plans have arisen from more of a grassroots phenomenon amongst conservation organizations such as The Conservation Fund.

Because of this, there is not a stringent methodology for formulating such a plan or legal requirements for its approval. Thus, Green Infrastructure Plans take many forms.

The Maryland GreenPrint Program, adopted at the state level, is implemented through the Maryland Department of Natural Resources and designed to acquire ecologically significant lands to develop a network of “hubs” (large acreage parcels of significant ecological value) and “corridors” (narrow parcels of land such as mountain ridges and stream valleys that are selected to serve as “highways” for native species). This program was created to increase the Maryland’s capacity and funding to acquire fee simple and easement properties in the face of rapid urban growth. These purchases are focused around its Green Infrastructure Assessment, a GIS and plan based strategy for ranking and defining statewide lands on ecological basis for acquisition purposes.

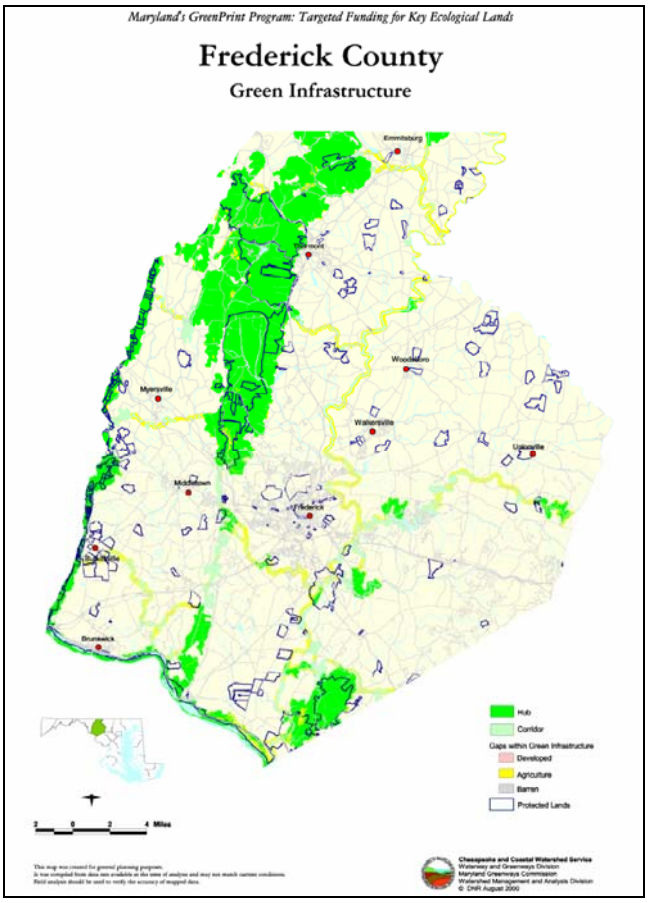


Figure 1. Frederick County Green Infrastructure Map from the Maryland GreenPrint Program – Light green areas define "hubs" and light green areas define "corridors" (Source: Maryland Department of Natural Resources, 2003)

The assessment includes the following elements: 1 – overview and background to the process and areas of interest, 2 – identification and definition of the network (the program's goal), 3 – ecological rankings of areas and habitat types per the defined hubs and corridors, 4 – threat rankings based on a given hub or corridor's level of protection and a matrix of factors that affect pressure to develop the land, 5 – cost estimates and acquisition priority maps for coordinating between partnered governments and organizations, 6 – fine scale evaluations of the ecological ranking and development risks, 7 – field evaluation principals and policies, 8 – management and restoration processes for

pieces of the green infrastructure network (Maryland Department of Natural Resources, 2003).

Regional Comprehensive Plans – Increasingly, communities are sensing the need for long term sustainability and incorporating aspects of habitat conservation into large-scale regional comprehensive plans. These plans are usually initiated by federal or state agencies that hold an interest in balancing urban growth and the preservation of conservation lands. While similar to Green Infrastructure Plans, for the purpose of this Case Study I draw a distinction between them by both conceptual (sustainability versus green infrastructure) and institutional (powerful federal or state agencies versus municipal or non-profit partnerships) driving forces. Generally, Regional Comprehensive Plans seem to treat conservation lands as "open space" or "green space", which tend to focus much more on the recreational or aesthetic values of land than ecological values.

The Sustainable Sandhills Initiative is an example of a relatively new comprehensive planning process initiated by the Fort Bragg Military Installation in North Carolina. Its aim is to implement a set of sustainable development goals amongst a group of municipal and county governments, federal and state and non-profit agencies, and public and private organizations. The Sustainable Sandhills Initiative began as a planning process led by the installation, but has since broken off as an independent non-profit organization. The organization has developed a comprehensive plan that addresses sustainability for counties surrounding the Fort Bragg Military Installation in the following areas: 1 – air, 2 – energy, 3 – land use, 4 – materials and waste and 5 – water. Still in its preliminary

phase, the land use plan component addresses three strategies: 1 – establish a program to analyze current and future policies, trends, laws and practices that affect land use in the study area, 2 – establish a partnership of diverse interests for developing a land use plan for the North Carolina Sandhills and 3 – raise the capacity for implementing the plan across the multi-jurisdictional area (Sustainable Sandhills Initiative, 2005). It is the aim of the Sandhills Conservation Partnership that the *Site Conservation Plan for the NC Sandhills* will be an integral component of developing the ecological and spatial principals for this land use plan.

"Conservation by Design" – The Nature Conservancy (hereafter TNC) is a non-profit organization whose single goal is the global preservation of all biodiversity. TNC implements this goal by purchasing fee simple and easement properties and cooperating with private landowners to apply management to restore natural communities. TNC has grown from a small, American conservation land trust to the world's largest and wealthiest conservation organization – owner and/or cooperative manager of a global network of ecologically rich lands. As such, TNC has attempted to use a systematic approach (see Figure 2, next page) to selecting conservation sites through a process it calls Ecoregional Planning. Ecoregional Planning generally focuses on quite large acreages of land (usually greater than 1 million acres) to determine where priority conservation projects should be focused and to develop a "portfolio" of conservation areas that, when managed properly, will preserve the majority of plants and animals indigenous to a given region (Groves et. al, 2000).

In the case of this study area, the North Carolina Sandhills Project was selected as one priority area from the Mid-Atlantic Coastal Plain Ecoregional Planning process. After this point, each individual project develops a Site Conservation Plan (usually focusing on lands less than 1 million acres) to narrow the scope of project personnel on the type of lands to be purchased and how to manage them for maximum ecological benefit. Beyond this, TNC often develops medium to long range (~5-20 year) management plans for each parcel or reserve. Many of these planning processes are based on data collected by the hard field work of state Natural Heritage program biologists and ecologists. These programs serve to inventory, monitor and collect data on plants, animals and insects in most states. State Natural Heritage Program staff members are also often participants of TNC's planning processes.

Figure 2. The Nature Conservancy's Planning Process – This process calls for an iterative, adaptive cycle that begins with ecoregional planning, then more detailed site planning, which leads to conservation action and evaluation ("measuring success").

Ecoregional Plans – TNC's Ecoregional Plans are based on eight steps that are intended to meet its organizational goal, while at the same time not creating too much of a focus on the planning process itself and thereby pulling limited resources (labor and capital)

from performing on the ground conservation and land purchases. These steps are: 1 – select conservation targets that represent the range in diversity of ecological systems, 2 – set conservation goals for each of the targets or groups of targets that focus on population numbers and distributions, 3 – assess the long term viability of the selected targets within the context of the planning area, 4 – assemble a portfolio of areas of biodiversity significance, 5 – "take action" by selecting conservation sites (i.e., the North Carolina Sandhills), 6 – subject planning efforts to internal and external peer review, 7 – maintain updated information and data resources to keep plans current, and 8 – assess the performance of conservation goals and objectives towards achieving their aim (Groves et. al., 2000).

Site Conservation Plans – For a given conservation site (Step 5, above), Site Conservation Plans are often written to guide the actions of project managers (TNC sometimes creates field offices for a conservation site – the area and office is called a "project"). The *Site Conservation Plan for the NC Sandhills*, the focus of this case study, was prepared and written under TNC's site conservation planning framework, known as the 5-S Process.

The process is identified by its five basic steps:

1. **S**ystems – Define the conservation targets occurring at a site and the natural processes that maintain them. These targets and processes will be the focus of the plan.

2. **S**tresses – Identify the types of degradation and impairment that affect the health and viability of the systems, or conservation targets.
3. **S**ources – Identify the human caused agents that generate stresses to the systems. The combination of stresses and sources composes the overall threat to a given target.
4. **S**trategies – Determine and select conservation activities that will abate the sources of stress (also, threat abatement) and persistent stresses (i.e., restoration).
5. **S**uccess – Select certain measures of biodiversity health and threat abatement to monitor the success of strategies and actions.

The 5-S process is designed to be adaptive and iterative, thereby allowing new or changing information to be incorporated into the ongoing planning process. Figure 3 illustrates the relationship between these planning steps as well as the types of strategies and data that influence the various steps (adapted from the *Nelson, 2004*).

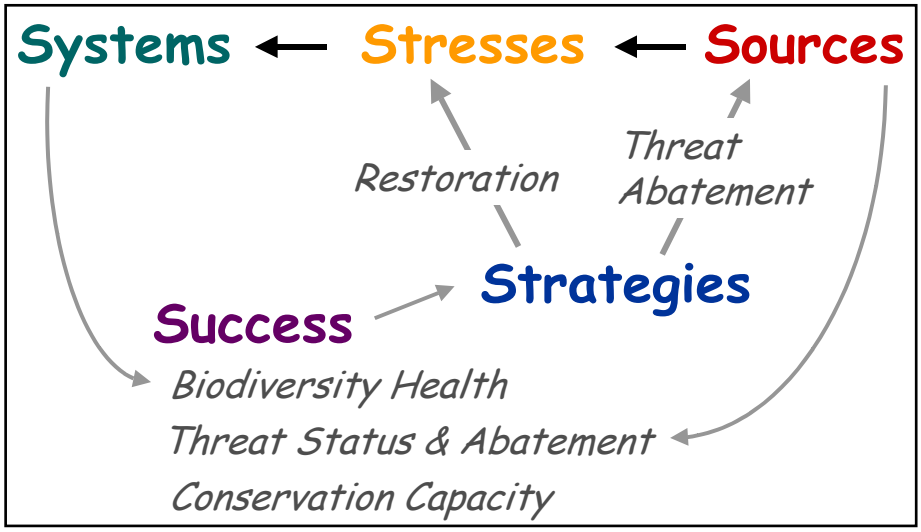


Figure 3. Conceptual Diagram of TNC's 5-S Process – The above diagram expresses the adaptive, iterative process by illustrating the connections and feedback between the different steps.

The prior examples illustrate that planning for biodiversity preservation arises from different circumstances and takes place in different formats. In the following part of the case study, I'll look in greater detail at the *Site Conservation Plan for the NC Sandhills* and the circumstances that lead to biodiversity planning, the format the plan took shape in, and the outcomes it sought for the protecting Sandhills biodiversity.

CHAPTER 5: THE IMPETUS FOR CONSERVATION PLANNING IN THE SANDHILLS[2]

In this case study, I will look at three aspects of the *Site Conservation Plan for the NC Sandhills*. First, I'll look at the context, both natural and human, from which the plan arose and the stakeholders who shared responsibility of developing it. Then I'll investigate the content of the resulting plan – the methods for its development, the framing of the document, the strategies created for preserving biodiversity and the ways it is prepared to evolve in the future. Finally, I'll look at the outcomes, both direct and indirect, that that are hoped for from the fullest implementation of the plan.

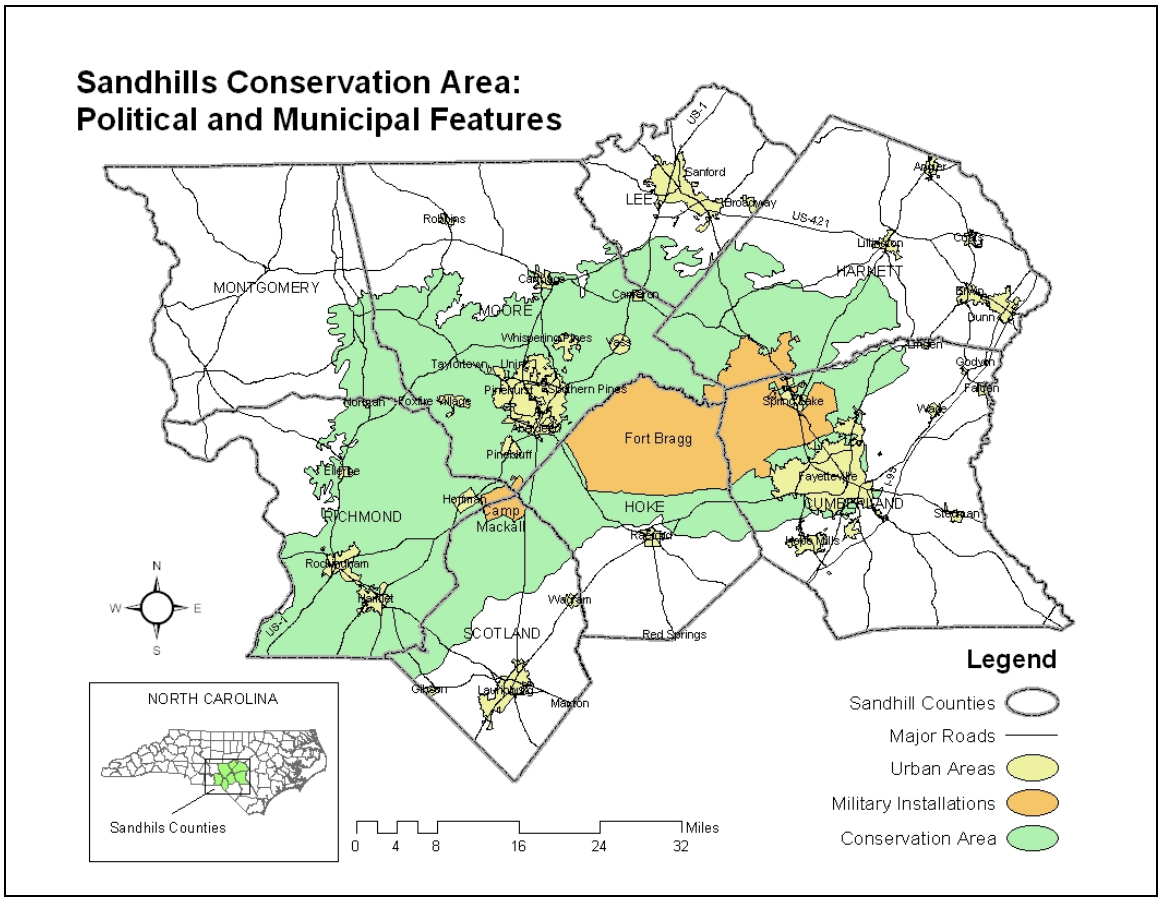
Sandhills Landscape Description

The North Carolina Sandhills is a region of roughly 900,000 acres located near the South Carolina border. The area is sandwiched between the coastal plain and Piedmont, known and defined by its characteristic sandy soils and expansive remnant longleaf pine forests. The boundary of the Sandhills conservation area is defined by the North Carolina portion of the Sandhills Fall-line, a series of highly diverse sandhills habitats formed by Pleistocene wind deposits. Sandhills biodiversity depends on a combination of relatively high rainfall, very porous, sandy soils and an active cycle of wildfires that creates a mosaic of longleaf pine community types. Longleaf pine forests, though once covering over 90 million acres of the Southeastern US, are now greatly diminished and fragmented by human development. The history and current status of human activities in the Sandhills has greatly reduced the intact longleaf pine habitat in the Sandhills with much

[2] Partially adapted from the Site Conservation Plan for the NC Sandhills (2004).

of this remnant within the boundaries of the Fort Bragg military installation. Fort Bragg, government agencies and other organizations are seeking to manage and protect this habitat not only for the now endangered red cockaded woodpecker and native biota, but also for military training purposes.

The Fall-line Sandhills was formed first by deposition of marine clays and sands in the Upper Cretaceous Period, followed by an influx of material carried by rivers from the Piedmont, and subsequently reworked by wind, weathering and erosion (Hall and Schafale, 1991 and Sorrie, 2004) (see Map 1, next page). This system supports up to 40% of the biodiversity of the North Carolina in just over 1 million acres, due to the diversity of topography, wetlands and drainages that result from these sandhill formations and clay based soils. The Fall-line Sandhills extends north from Georgia to South Carolina into southern North Carolina, including northern Hoke, eastern Richmond, northern Scotland, western Cumberland, Harnett, southern Moore and southern Lee counties of North Carolina.



Map 1 - Sanhills Area Map 1

Despite the extensive xeric (dry soil) communities that compose much of the area, the Sandhills has a humid subtropical climate and experiences relatively high levels of precipitation. On average, the area receives from 46-49 inches of annual precipitation evenly distributed throughout the year, with summer high temperatures averaging from ~83-92^{o}F and winter high temperatures averaging ~52-64^{o}F[3]. Natural disturbance is an important element of the Sandhills ecosystem. Rapid drainage of precipitation supports an active fire regime. Wildfires are ignited an average 45 days each year by thunderstorms and human activities (both pre and post European colonization).

[3] Figures averaged from historic climate summaries from the Southeast Regional Climate Center, found at http://www.dnr.state.sc.us/climate/sercc/climateinfo/historical/historical_nc.html.

Furthermore, tropical storms and hurricanes have important roles in the system by causing blowdown events that create gaps in pine and hardwood stands to further

The vital importance of fire's dominance in the Sandhills' longleaf pine ecosystem has not diminished despite vast changes in fire frequency due to suppression and habitat conversion[4] over the past 200 years. Two of the most dominant species, longleaf pine and wiregrass, are specifically adapted for active fire regimes and thrive in frequent burn cycles. Some plants are specifically adapted to survive fire events; others tend to colonize newly burned patches. Many of the vegetative species in the Sandhills ecosystem have low reproductive rates or require fire occurrence to release seed or stimulate seed production. Furthermore, the habitat structure and species composition of Sandhills natural communities is highly determined by fire frequency – for some, fire suppression leads to hardwood overgrowth and decreasing levels of species richness. For others, fire suppression decreases the ability for seed to spread or take root. The ability for this natural fire regime to exist on the scale it once did is no longer possible due to the complexity of human development in the area. Now, fire must be prescribed, ignited and managed according to standards that protect human communities while perpetuating natural communities.

Sandhills land managers and biologists estimate more than 150,000 acres of intact natural longleaf pine community to remain in the area (Schafale and Studenmund, 2004), and great biodiversity results from the combination of topographical relief, higher elevation

[4] Thus, reducing fire's ability to spread across roads and increasing the tendency for human suppression near homes and agricultural sites.

than other coastal plain sites, coarse textured soil layers alternating with fine-textured clays, and distinct landscape features such as cemented stone outcrops, river terraces and innumerable streamheads and seepage slopes. This diversity includes rare species, rivaling the southeast coastal plain to the east for the greatest number of rare species and exceeding it for greatest amount of rare populations in the state (Schafale, 1994 and Sorrie, 2004). The North Carolina Natural Heritage Program has classified 18 distinct community types for the Sandhills. Each type differs in hydrology, soils, species composition, dynamics, fire regime, and biological associations, and each type provides a different set of ecological functions and services.

Historic Context

The Sandhills area was one of the last places to be settled on the North Carolina coastal plain, largely due to the dry acidic soils that limited agricultural conversion during colonial times. In the early 1800s, the naval stores industry became the first serious human venture for the extraction of rosin, tar, pitch and turpentine from the longleaf pine. This practice peaked in the 1850s around the time when logging of vast stands of virgin longleaf picked up. Logging pace increased as railroads were built into the region in the latter 1800s, and by 1920 most of the virgin longleaf had been cut throughout the Southeast. Free-range cattle and hogs were also an important industry throughout this time, and by 1850 the coastal plain and parts of the Sandhills had reached saturation density for these animals. Though stock laws were passed in the early 1900s, this type of hog and cattle grazing had great affects on the Sandhills vegetative structure (Schafale, 1994).

Fire frequency likely increased for a time, when white settlers adopted local Native American practices of burning open longleaf stands. However, as roads, fields and houses became more numerous, landscape fragmentation and suppression eliminated the ability for natural wildfire to occur. This lack of fire led to fuel accumulation, creating conditions for more intense fires over much longer time intervals (Schafale, 1994). Now the closest resemblance to a natural fire regime can currently be found on Fort Bragg's impact areas, where bombing practices lead to frequent fire ignitions and prescribed burns allow for more natural fuel loads.

The Fort Bragg/Pope Air Force Base is a key US military installation used for the training and deployment of troops and equipment. The installation is easily the primary economic engine of the Sandhills. It supports 253,000 people and is estimated to have an overall economic impact of $3.5 billion, with considerable implications to the region's economic wellbeing (Dougherty, 2003). The installation is also a major stronghold for remaining endangered red cockaded woodpecker populations, largely due to its indirect management and support of healthy longleaf pine forest communities (as well as incidental fire frequency). The preservation of intact habitat not only provides the military with quality sites for infantry and light armored training practices, but it also aids the Army's compliance with federally mandated management for the red cockaded woodpecker, set into law by the Endangered Species Act of 1973. Currently, the Army manages for these endangered species populations through prescribed fire, stringent

training rules, and habitat development (i.e., drilling nesting cavities) for the red cockaded woodpecker.

In its creation, the base had annexed its 160,000 acres from four counties - Cumberland, Hartnett, Hoke and Moore counties (Richmond and Scotland counties also have land within the Sandhills boundary). The loss of nearly 1/3 of Hoke County's land area to the base has remains a source of contention with some Hoke County residents to this day (Kent, 2000). The city of Fayetteville is the major source of people and services to the installation. Fayetteville was a town of 8,900 when Fort Bragg was created in 1918 when it was located nearly 10 miles from its boundary. Since then, the city has grown steadily to its present population of over 130,000 and to a shared boundary on the base's southern edge. This growth has led to substantial home building in rural areas surrounding Fort Bragg. Furthermore, local planners and land trust managers felt that the proposed (and now current) expansion of state highways servicing the Sandhills from the Triangle cities of Raleigh, Durham and Chapel Hill would further stimulate this type of growth in the near future. However, to date the area has remained in relatively sparse residential development, supporting a variety resource and tourism-based industries such as pinestraw raking, horse farming and golf tourism. Where agricultural uses have traditionally been in timber, tobacco and stock farming, more recently pine straw raking has become predominant on private and some public forests, while tobacco has become less so (Schafale, 1994).

Over the past 15 years, residential development around Fort Bragg has fragmented habitat corridors as well as created encroachment issues that have reduced the military's capabilities to train effectively. In 1991, the Regional Land Use Advisory Committee was formed to generate discussion and coordinate planning efforts of Fort Bragg, Pope Air Force Base and neighboring counties and municipalities to address issues pertaining to encroachment and training. In 2003, these efforts were continued with the issuance of the *Joint Land Use Study*, which recommended the protection of certain land parcels within a one-mile study area surrounding the base by designation of important and critical sites. The recommendations from this study received mixed reception from neighboring counties and municipalities.

Issues and Impetus for Fort Bragg

The importance of the Fort Bragg installation for training military personnel and subsequent surrounding urban growth has led to some limitations and pending threats of more severe limitations on the capabilities of the Base. Table 1 (next page) outlines the major issues to Fort Bragg resulting from growth in the Sandhills and subsequent impetus to tackling the preservation of the longleaf pine forest and recovery of the Sandhills red cockaded woodpecker population.

Table 1 – Issues and Complexities[5]

Issue	Complexities
Residential encroachment on Fort Bragg	The installation attracts growth, but this growth limits the installations capabilities
Red cockaded woodpecker recovery and Longleaf forest management constraints	Development growth further stresses red cockaded woodpecker habitat, Fort Bragg is the primary habitat source and needs to recover red cockaded woodpecker populations to remove some training restraints
Environment vs. economic development conflicts	Protection of habitat and training areas are key for Fort Bragg and environmental orgs - This removes tax base and raises land prices
Equity	Fort Bragg needs a protected buffer of key lands around the base - Installation personnel and local residents need affordable housing
Institutional arrangements	Vast diversity in stakeholders and interests - Multiple overlaps in jurisdictions, boundaries and planning areas

Over the past twenty years, residential developments have begun to spread around the Base's perimeter, leading to the closing of several tank drop zones due to safety concerns and noise complaints, and reductions in small arms training in some areas due to light pollution. Also limiting training is required management and sensitivities to the endangered red cockaded woodpecker, which requires that heavy equipment and artillery use be kept outside a delimited perimeter of each marked red cockaded woodpecker nest. With growth in residential housing around the base, golf courses and golf communities and subdivided horse farms of decreasing size, habitat fragmentation of the longleaf pine

[5] Items under the *Complexities* column list the basic nuances of a given issue (Source: Dougherty et. al., 2003)

forest has stressed the natural requirements of the red cockaded woodpecker to thrive in the Sandhills.

Three major implications result from the above issues:

1. One of the primary fears of Fort Bragg and many Sandhills residents is that, given the spate of nation-wide base closings, reductions in the base's training capability may eventually lead to its demise. Were the base to close, there would be an immense toll on the area's service economy. Though the closing of Fort Bragg is not a likely possibility in the short term given its size and importance, the thought of losing the base may have made many residents and businesses more willing to cooperate on land use issues such as protection of the red cockaded woodpecker that might otherwise have received hostile treatment.

2. The loss of available, quality Longleaf habitat not only stresses or reduces red cockaded woodpecker populations, but residential growth also fragments training areas that are used for orienteering and war games exercises (reducing the size of navigable areas), small arms training (with concerns about safety of nearby buildings and people) and brings soldiers and residents in more frequent and less desirable contact.

3. Imbalance between the needs of the base and those of local residents and governments will also lead to casualties in social equity or environmental health.

> With a rise in affluent small horse farms and golf course communities and removal of sizeable tracts of land for protection status, land and housing prices may squeeze the budgets of many low income families that have traditionally been able to afford land in the area.

Fort Bragg has turned to the US Fish and Wildlife Service, charged with the duty of enforcing the Endangered Species Act, to assist in attempts to recover the red cockaded woodpecker population from its endangered status and, thus, remove training restrictions around nest areas (Dougherty et. al., 2003). The Joint Land Use Study, commissioned by the Regional Land Use Advisory Commission, has also made recommendations to adjacent counties and municipalities to enact land use policies to reduce these growth factors by, among other things, protecting key lands in a one mile buffer surrounding the base. This initiative has lead to concerns amongst Sandhills residents and governments over takings of private property of those within the buffer, pricing out low income residents by phasing out of mobile home communities and the loss of tax base by protecting lands in an area with already high percentages of un-taxable Federal and State lands (Kent, 2000).

The North Carolina Sandhills Conservation Partnership

The combination of historic and current land uses, fragmented critical habitat, and trends of significant future population growth and urbanization reemphasized the importance of identifying the conservation needs of the area and mobilizing effective action and the development of the Sandhills Conservation Partnership in 2000. This partnership is

heavily supported by Fort Bragg's political and financial weight in the Sandhills. The mission of the Sandhills Conservation Partnership is to "coordinate the development and implementation of conservation strategies for the red-cockaded woodpecker, other native biota, longleaf pine and other ecosystems in the Sandhills of North Carolina compatible with the land use objective of the partners" (North Carolina Sandhills Conservation Partnership Communications Group, 2004). The Partnership is composed of seven organizations that have signed a cooperative charter: Army Environmental Center, Fort Bragg, Sandhills Ecological Institute, North Carolina Wildlife Resource Commission, The Nature Conservancy, Sandhills Area Land Trust and US Fish and Wildlife Service.

Other organizations lend input to the Partnership, especially through participation in the six working groups tasked with developing conservation strategies and actions. These six working groups are established for the following purposes:

- The Red Cockaded Woodpecker Working Group identifies key areas of landscape that need protection in order to recover the red-cockaded woodpecker population.
- The Land Protection Working Group identifies sources of funding and strategic properties that will increase the protection for key ecological resources.
- The Reserve Design Working Group develops, maintains and updates a conservation design that accounts for "all existing land use plans, relevant data and applicable land use tools and processes" (Sandhills Conservation Partnership, 2004)
- The Natural Resource Working Group identifies issues regarding the longleaf ecosystem management and develops recommendations to resolve the issues.

- The GIS Working Group has developed a central GIS database through the NC Department of Commerce, Division of Community Assistance and works to streamline data sharing and resolve data issues.
- The Communications Working Group maintains open lines of communication between partners and develops methods for joint strategies of community relations and educational opportunities.

CHAPTER 6: DEVELOPMENT AND PROCESS OF CREATING THE SITE CONSERVATION PLAN FOR THE NC SANDHILLS

Introduction

The *Conservation Plan* was written to fulfill two organizational objectives. First, The Nature Conservancy Sandhills Project sought to create a landscape-scale conservation plan based on ecological features that focuses conservation efforts and effectively allocates resources for protecting biodiversity. Second, the North Carolina Sandhills Conservation Partnership sought to develop a comprehensive conservation plan for the Sandhills that incorporated new and existing cooperative action within its partners, as well develop joint ventures outside the partnership with community and government organizations.

Because of these two overlapping objectives, the *Conservation Plan* was jointly funded by The Nature Conservancy and US Fish and Wildlife Service, two representatives of the partnership. By the adoption and implementation of the *Conservation Plan*, the partnership hoped to further its mission, strengthen its capacity for applying conservation strategies and broaden the network of cooperation in conservation work in the Sandhills.

Process Development

The planning process was initially begun in the summer of 2000 by a Nature Conservancy planning team composed of several North Carolina Chapter staff. In a weeklong process, the staff worked through what was then known as the Effroymsen

workbook, a Microsoft Excel based decision support tool for framing the planning process[6]. This process was not completed in a report format, but helped to initiate the setup of the Sandhills Project, a regional office located in Southern Pines, North Carolina, to house a project director, fire management officer and several staff. In 2001, the Nature Conservancy, US Fish and Wildlife Service, Army Environmental Center and Sandhills Area Land Trust teamed up under the same roof, thus creating the Conservation Center for the Sandhills to pool human and capital resources and create a space for networking and developing the capabilities of the Sandhills Conservation Partnership.

As the institutional capacity of the partnership grew, so did the recognition that the partnered institutions should frame their collective strategy in a written document. In the spring of 2004, The Nature Conservancy's Sandhills Project and the US Fish and Wildlife jointly funded a conservation planning intern to synthesize the collective work that had been done over the past few years. This process was begun in the summer of 2004 with a series of two workshops that brought in members of the partnered institutions, as well as a community ecologist and conservation protection specialist from the North Carolina Natural Heritage Program and planners from the State's Fayetteville Division of Community Assistance office. In these workshops, the group used an updated version of the Effroymsen workbook to frame and document the conversation of how to address the preservation of Sandhills biodiversity.

[6] More details on the Effroymsen workbook will follow in the next section.

The Effroymsen Workbook

The Effroymsen workbook is a Microsoft Excel based software application that allows users to proceed through The Nature Conservancy's 5-S process methodologically (see Figure 2 for screenshot of workbook frontpage). The workbook includes five distinct worksheets, many of which contain macros that allow cross referencing between them. Users of the workbook can proceed through a target viability assessment, identify stresses and sources of stress, develop a strategy framework, detail a monitoring plan and rank project resources. By proceeding in order through the process, the workbook allows further detail to be added to each step by making connections between targets, threats and strategies.

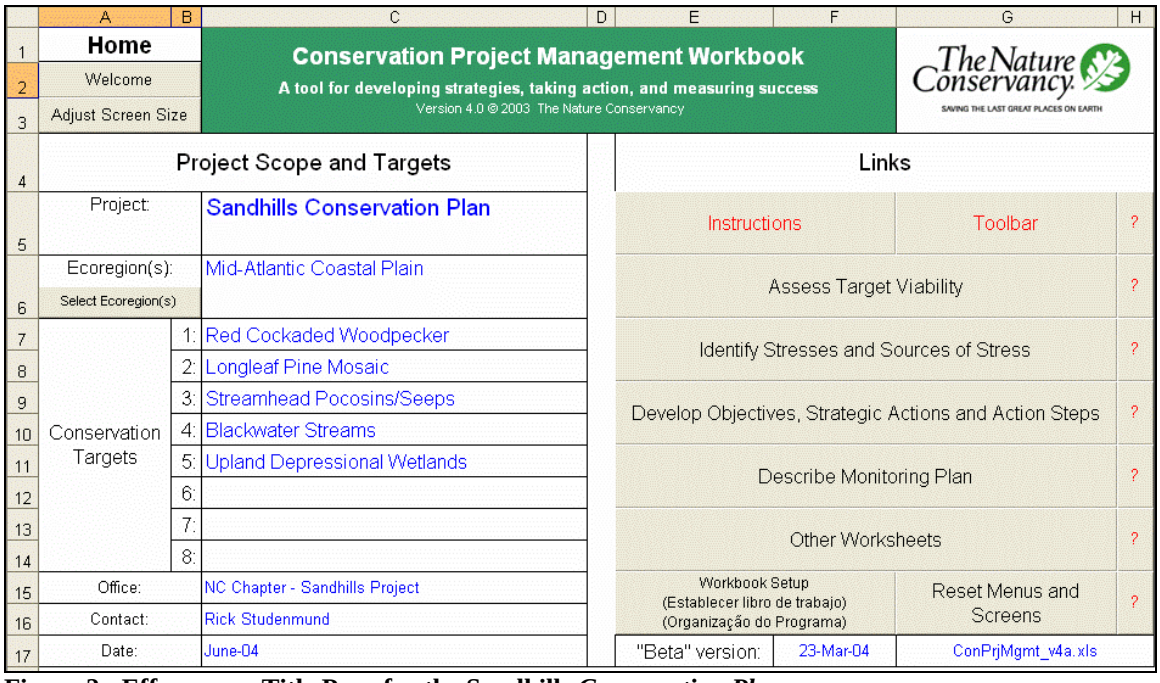


Figure 2 - Effroymsen Title Page for the Sandhills *Conservation Plan*

Workshops I and II in the Sandhills conservation planning process used this workbook as a framework to orient the dialogue and document participant input. During these

workshops, the group proceeded through three "wizard" applications (target viability, threats and strategy framework) to enter tabular information in. These applications provided lists of preset choices that allowed the group to choose, or base new definitions on the various topics that the group discussed in each workshop (see Figure 3, next page).

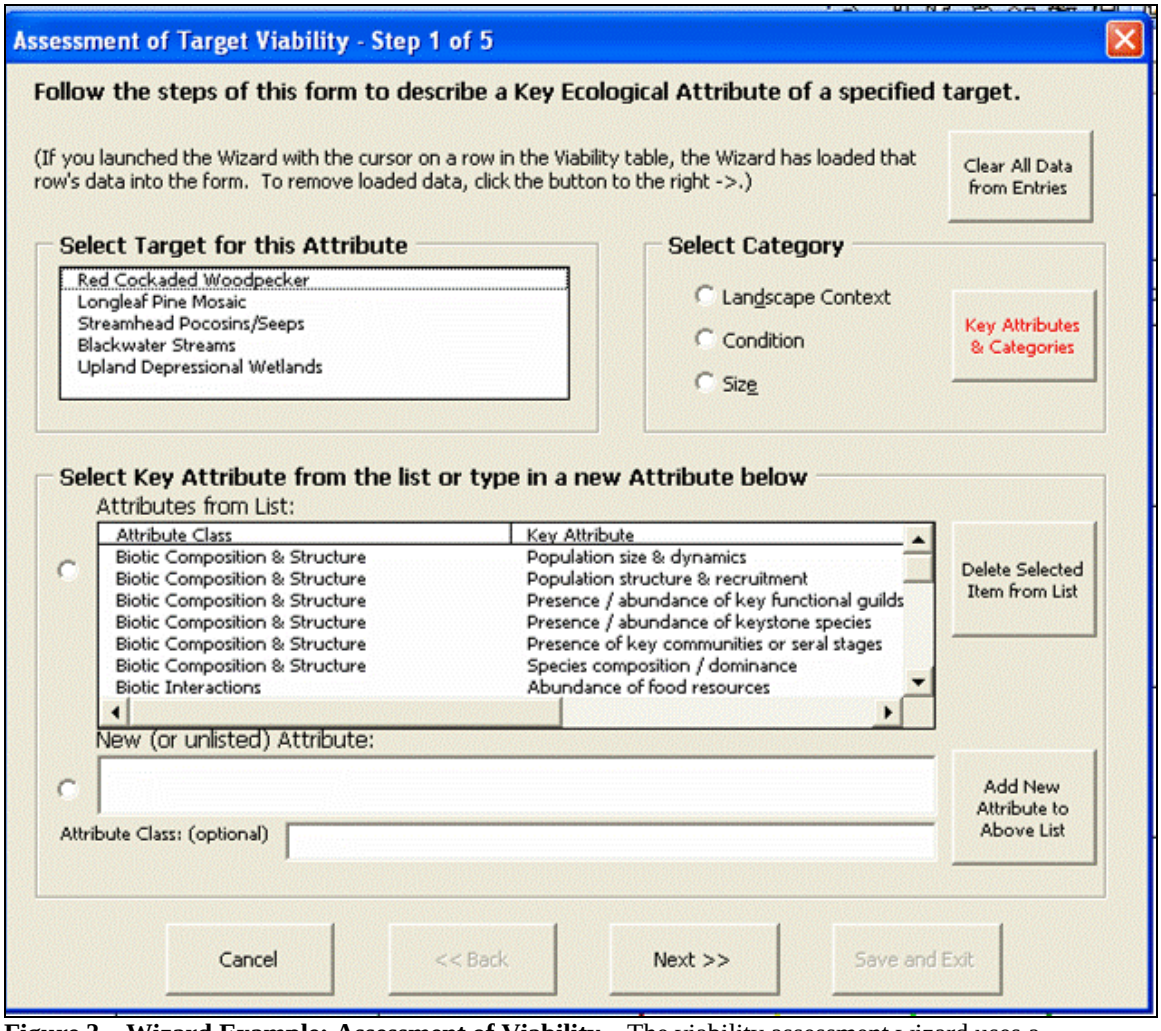


Figure 3 – Wizard Example: Assessment of Viability – The viability assessment wizard uses a combination of preset selections to define the biodiversity characteristics of the study area.

The group also assessed Sandhills biodiversity by ranking threats per target. Each of these rankings was scored according to a macro, or script, that weighed the collective

rankings of each (see Figure 4, next page) selection to provide an overall threat ranking to each target. For example, “Secondary Home Development” would be seen as a “High” ranking threat to the red cockaded woodpecker because of the fragmentation effects it would have on the forage and nesting habitat requirements. This threat, coupled with all other threats, ended up with the highest ranking overall threat for selected targets.

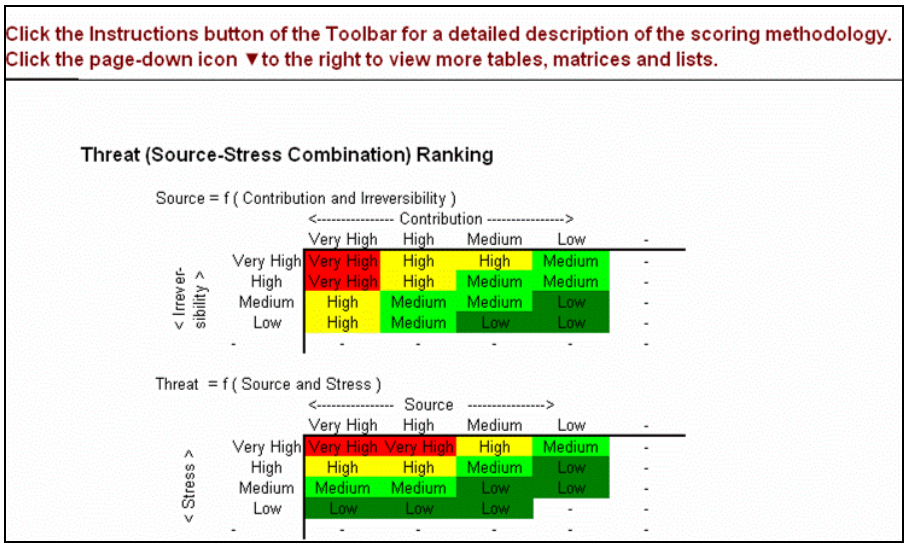


Figure 4 - Rankings Scores – The above example illustrates the methods that the Effroymsen workbook calculates overall threat rankings to a specific target. For example, the red cockaded woodpecker might receive a high stress rating from “altered natural fire regime” combined with a high source ranking from “altered fire regime” to receive a very high overall threat ranking.

There was a good deal of well-placed concern by many of the participants over the constraining nature of present selections for describing Sandhills biodiversity. However, the workbook was seen by most as a guidance tool for keeping the group on track throughout the workshops. There was simply too much information and too little time to attempt to capture group consensus on open discussion. The workbook provided a relatively successful format to follow with the process, though at times the language and tool itself became a burden for keeping the flow of the workshop going.

Process Continuation

In Workshop I, the group focused on framing and defining the biodiversity of the Sandhills. This included narrowing the scope of the plan to biodiversity targets and ranking threats for each of these targets. Workshop II took place two weeks later, where the group continued this process by completing the ranking process for threats and generating a list of strategies to address the identified threats. This information was then assimilated into a rough document for internal review, and further developed into a rough draft that was sent out to Workshop participants for peer review. The first draft of the *Conservation Plan* was then completed in November of 2004. The plan is currently under review and is expected to be adopted by the NC Sandhills Conservation Partnership by spring, 2005.

The partnership seeks to continue this process a step further by incorporating spatial analysis of threats, targets and strategies through Geographic Information Systems (GIS). By doing so, the partners hope to develop a more analytical framework to base their acquisition and management strategies on. The development of this spatial analysis project will be an ongoing aspect of the *Conservation Plan* and source of exploration in the final *Discussion* section.

CHAPTER 7: RESULTING CONTENTS OF THE *SITE CONSERVATION PLAN FOR THE NC SANDHILLS*

Introduction

The structure of the *Site Conservation Plan for the NC Sandhills* is based on The Nature Conservancy's Conservation by Design planning framework. The plan begins with a landscape description and target selection to focus the plan on specific entities of biodiversity. The plan then provides a Biodiversity Assessment, which outlines measures for monitoring the success of the ultimately selected conservation strategies. In the Stresses and Threats Analysis sections, the plan describes human land uses that are though to be degrading the habitat quality of Sandhills biodiversity. The Strategy Framework section then outlines the partnership's means to addressing these threats towards protecting and enhancing Sandhills biodiversity. Two sections remain unfinished: a Stakeholder Analysis and a Monitoring Program. The partnership hopes to complete these sections, as well as continually refine the list of strategies, threats and even targets through the adaptive, iterative process of Conservation by Design. The following chapter will describe the plan's major sections in greater detail.

Target Selection

Conservation targets (targets), as defined by The Nature Conservancy, may include ecological systems, ecological communities, or species[7]. These targets are defined as follows:

- Ecological systems are spatial assemblages of ecological communities, either occurring together on a given landscape or linked by ecological processes.
- Ecological communities are groupings of co-occurring species.
- Species are chosen as targets when a species is: 1 – imperiled or endangered, 2 – ranked of special concern due to recent trends, 3 – a focal (i.e., keystone) species, 4 – of similar habitat or requirements as major groupings of species, or 5 – an aggregation of global significance.

The purpose for selecting targets was to focus the planning effort and guide conservation strategies in the Sandhills conservation area. Threats and stresses to the area's biodiversity are identified based on the selected targets, and the resulting strategies focus on methods of alleviating the stresses or mitigating the threats that may potentially destroy elements of biodiversity in the Sandhills area.

For the Sandhills Conservation Plan, targets were selected in Workshop I after discussion of representative species, community types and ecosystems, with an ultimate goal of 95% representation for biodiversity in the Sandhills by 8 or fewer targets. The selection of the targets originated from the 6 targets previously chosen by the first Nature Conservancy

[7] For greater detail on The Nature Conservancy's 5-S framework, see *The Five-S Framework of Site Conservation: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success*. The Nature Conservancy. Arlington, VA. Third Edition: 2003.

Sandhills planning team in 2000. One aspect of the conversation was focused around the concept of dividing a target by public and private areas due to the diverse threats and strategies that would be applied to each type of ownership. However, it was decided that such a separation could be considered arbitrary and that the related concerns would be addressed in future steps of the planning process. Further discourse lead to the ultimate selection of targets and justifications listed in Table 1.

Target Biodiversity Summary

Table 2 lists the selected targets, related target justification and nested targets. Nested Targets represented important natural communities or species that perform critical roles in the ecology of the selected target, but do not warrant individual listing as a conservation target for planning purposes. These nested targets were listed to illustrate important aspects of biodiversity and to guide subsequent steps of the planning process.

Target	Target Selection Justification	Nested Targets
Red-cockaded Woodpecker*	Federally endangered species, "keystone" species	Old-growth longleaf pine Carolina wiregrass
Longleaf Pine Mosaic**	Longleaf community types encompass the primary source of biodiversity in the Sandhills and have experienced great losses in original habitat extent	Small patch communities, rare plants, rare animals, matrix community types
Streamhead Pocosins/Seeps**	Habitat for rare plants and animals, sensitive to diverse sets of environmental factors	Canebrakes, Sandhills seeps, Streamhead Atlantic white cedar, Streamhead pocosins, rare plants, rare animals, lepidoptera
Blackwater Streams**	Healthy aquatic systems that are newly threatened by increasing development	Beaver pond communities, floodplain forests and rare species, aquatic communities and rare species
Upland Depressional Wetlands**	Habitat for rare plants and animals, sensitive to diverse sets of environmental factors	Small depressional ponds, vernal pools, rare herps, rare plants, small depressional pocosins and swamps

Table 2: Target Biodiversity Summary (* The red-cockaded woodpecker is a species target, **All other selected targets are ecological systems targets.)

Biodiversity Health Assessment

The goal of performing a biodiversity health assessment on the Sandhills conservation targets was to develop an understanding of the current overall status for each target. By doing so, participants of Workshop I could identify the steps that needed to be taken to manage for or restore the natural processes that each target depends on to thrive in its undisturbed state. The assessment was also to serve as a point of reference for future assessments in order to measure the amount of progress that has been made through the chosen strategies of the *Conservation Plan*.

The description of biodiversity health for each target was based on 3 factors:

- Size – the measure of area or abundance of the conservation target's occurrence. For ecological systems and communities, size may simply be a measure of the occurrence's patch size or geographic coverage. For animal and plant species, size takes into account the area of occupancy and number of individuals. Minimum dynamic area, or the area needed to ensure survival or re-establishment of a target after disturbance, is another aspect of size.
- Condition – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence of the target. Examples include: reproduction, age structure, biological composition, physical and spatial structure, and biotic interactions that directly involve the target.
- Landscape Context – an integrated measure of both the dominant environmental regimes and processes that establish and maintain the target occurrence as well as connectivity.

By first determining how to measure the biodiversity health of the Sandhills, the *Conservation Plan* participants of Workshop I were able to base subsequent steps of identifying threats to the selected conservation targets, determining strategies to abate those threats and, finally, monitoring the health of Sandhills biodiversity and success of the chosen strategies. Gaining an understanding of the complex interactions of Sandhills ecological communities was viewed an iterative process by Workshop I, and the *Conservation Plan* was expected to require consistent refining as these systems become better understood.

Stresses

The stresses identified for the *Sandhills Conservation Plan* were based on The Nature Conservancy's definition as human-caused destruction, degradation or impairment of focal conservation targets. Although natural processes such as wildfires, beaver dams and hurricanes also cause changes to conservation targets, these processes are considered to be disturbances that enhance the ecology of a region by creating a mosaic of compatible, biodiversity rich ecosystems and communities. Human actions that lead to impairments, however, cause changes to the key attributes (such as the attributes identified in *Biodiversity Health*) of a given conservation target that reduce its ability to function in the natural system. Therefore, the *Conservation Plan* identified stresses as altered key attributes. The altered key attributes listed in the Table 3 (below) are simplified adaptations of the key attributes that were defined in the *Biodiversity Health Assessment*. This table lists the ranked contribution of each stress to a given target.

Table 3: Stress Matrix Summary Table

	Stresses (Altered Key Ecological Attributes) Across Systems	Red-cockaded Woodpecker	Longleaf Pine Mosaic	Streamhead Pocosins/Seeps	Blackwater Streams	Upland Depressional Wetlands
1	Altered composition/structure	Medium	Very High	Low	High	-
2	Altered hydrologic regime	-	-	-	Medium	-
3	Altered natural fire regime	Very High	High	High	-	Medium
4	Altered predator/prey relationships	-	Medium	Low	Low	-
5	Habitat destruction or conversion	High	Medium	Medium	-	Medium
6	Habitat fragmentation	High	Medium	-	-	-
7	Loss of landscape context (destruction of uplands habitat)	-	-	-	-	High
8	Nutrient loading	-	-	-	High	-
9	Sedimentation	-	-	Medium	Medium	Medium
10	Toxins/contaminants	-	-	-	Low	-

Threats Analysis

The sources of stress or threats to the health and vitality of Sandhills conservation targets were identified in Workshop I according to an emphasis on current and proximate human causes. A threat is current if the action is not only presently active but expected to deliver additional stresses to a target over the next 10 years. A threat is considered historic if the current stresses will likely persist over the next 10 years, but the source of the stress is no longer active. Furthermore, the threats identified in this analysis were proximate to definitive activities (i.e., primary home development), as opposed to general or indirect actions (i.e., population growth). To increase the precision of these threats, definitions

were created to further specify which human activities the *Conservation Plan* addresses and which targets these activities affect.

Ultimately, the threats and stresses analyzed led to the conservation strategies that were selected to focus the efforts of the Partnership. These strategies focus on threat abatement, considering both the stress and its source. By doing so, two types of threats led to different kinds of strategies. Abatement strategies focus on highly ranked threats with active sources of stress. Restoration strategies focus on highly ranked threats with persistent or historic sources of stress. A third type of strategy is to build capacity through means of improving policy, building organizational strength or recruiting additional partners. A summary of these threats and the threat rankings per each target can be found in Table 3 on the following page.

Table 3: Threats Summary Table

	Threats Across Systems	Red cockaded Woodpecker	Longleaf Pine Mosaic	Streamhead Pocosins/Seeps	Blackwater Streams	Upland Depressional Wetlands	Overall Threat Rank
1	Primary home development	Very High	High	High	Low	High	Very High
2	Fire suppression/ inhibitions to the use of prescribed fire	Very High	High	High	-	Medium	High
3	Forestry practices	Very High	High	-	High	-	High
4	Second home/resort development	Very High	High	High	-	-	High
5	Pine Straw Production	High	Medium	-	-	-	Medium
6	Roads	-	-	Medium	-	High	Medium
7	Small dams on headwater tributaries	-	-	High	Low	-	Medium
8	Golf course construction and maintenance	-	-	-	Low	High	Medium
9	Livestock production practices	-	-	-	Medium	-	Low
10	Wastewater treatment	-	-	-	Low	-	Low
Threat Status for Targets and Site		Very High	High	High	Medium	High	Very High

Strategy Framework

The *Conservation Strategy Framework* outlined the strategies that could be undertaken to ensure the long-term success of the selected conservation targets. These strategies were the actions that hold the most promise to either directly or indirectly abate the threats that are currently weakening the biodiversity health of Sandhills conservation targets.

The *Conservation Strategy Framework* included strategies of 3 distinguishing categories:

- *Threat abatement strategies* remove or reduce active sources of stress to a conservation target (i.e., purchasing conservation easements to prevent residential development).
- *Restoration strategies* directly work to reduce human caused stresses or restore natural functions to a conservation target (i.e., restoring riparian buffers so as to reduce stream sedimentation).
- *Capacity building strategies* work to engage stakeholders, promote priority policies, offer compatible development alternatives, or otherwise develop the capabilities of the Partnership to engage in conservation work in the Sandhills.

In the *Conservation Strategy Framework*, sets of these strategies were organized under conservation objectives. Objectives were defined as "specific statements detailing the desired accomplishments or outcomes of a particular set of activities within a project."[8] These objectives aimed at ultimately achieving the Partnership's mission, which is stated below:

[8] 2003. The Nature Conservancy. *The Enhanced 5-S Project Management Process.* The Nature Conservancy.

> The North Carolina Sandhills Conservation Partnership was established to coordinate the development and implementation of conservation strategies for the red-cockaded woodpecker, other native biota, longleaf pine and other ecosystems in the Sandhills of North Carolina compatible with the land use objective of the partners.

The strategies and objectives for the *Conservation Plan* were generated in Workshop II in June 2004. Thirteen objectives and 65 strategies were identified in brainstorming sessions through group discussion and entered into the *Conservation Project Management Workbook v.4.0a* (Effroymsen) tool. Later, the strategies were ranked by overall benefit to the selected conservation targets, overall feasibility and overall cost. This set of strategies and objectives, along with the ranking scheme, were then sent out to the participants of Peer Review. From the critique generated by this review, a list of 37 strategies and 10 objectives were selected for the final *Conservation Strategy Framework* (see Appendix A).

Monitoring Program

The *Conservation Plan* was designed to be an adaptive, iterative document that continually addressed the dynamic ecological processes and status of Sandhills biodiversity. As such, it was necessary to measure the progress and success of strategies and actions that the Partnership takes. To do so required an active monitoring program that measured the very elements of biological health that had been selected to develop the *Strategy Framework*. These elements were to be the same measurable indicators of status

or trend that were selected to determine the *Biodiversity Health Assessment* of Sandhills targets.

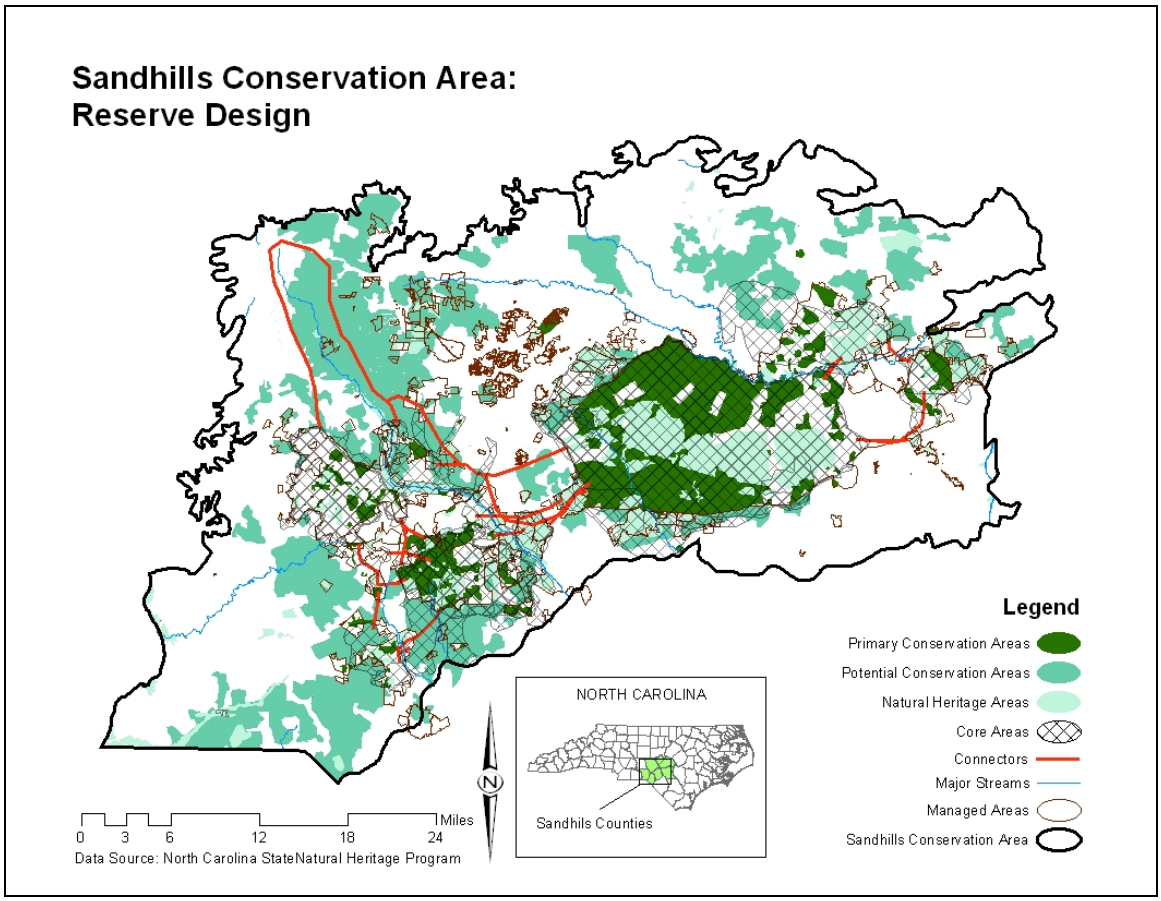
Indicators were defined as measurable factors of conservation targets that could be quantitatively and qualitatively monitored to test the success the three types of strategy described in the *Strategy Framework*: threat abatement, restoration of biodiversity health and capacity building. Indicators for biodiversity health measured threat abatement and restoration strategies, whereas indicators of capacity building were based on the achievement of increasing organizational strength with relation to the chosen capacity building strategies.

The monitoring program was to be a cooperative venture, whereby the full measure of Sandhills biodiversity was measured by the agreed upon indicators listed in the *Conservation Plan*. These indicators were to be divided effectively amongst partners and field personnel, with a strategy for communication and centralized data management to process and update current understanding of conservation target health.

Current and Future Studies

The Partnership's mission of protecting Sandhills biodiversity was greatly aided by inventory, research and analysis performed by various organizations. Primary among those was the extensive inventory and classification that has been performed by the North Carolina Natural Heritage Program and the development of a "Reserve Design" for the area (see *Map 2, next page*), which identified areas of the greatest overall biological value

and diversity. With the advent of Geographic Information Systems (GIS) technology allowing for a more precise and extensive spatial understanding of an area than has been possible in years prior, the partnership sought the ability to perform further spatial analysis on Sandhills targets with consideration to the identified threats and strategies is a major priority for future drafts of the *Conservation Plan*. The end sought was to develop a spatially accurate, comprehensive, scientifically based protection design for the Sandhills that could be continually updated with the most current data. This design would, like the Reserve Design, maintain an account of the lands with greatest biological value but, unlike the Reserve Design, also take into consideration threats such as changing rates and locations of urbanization and infrastructure development, as well as strategies such as possible biological corridors or compatible land uses.



Map 2 - Reserve Design for the NC Sandhills

The *Current and Future Studies and Analysis* section catalogued existing studies and ideas for future studies that will aid Sandhills conservation efforts. The *Current Studies* section listed, by citation, and gave short descriptions of studies that had been performed and were specific and applicable to the Partnership's mission. The *Future Studies* section listed research or analysis needs to fulfill purposes of inventory, biodiversity health, threats analysis or protection design.

Stakeholder Analysis

An important element that was not fully included in the *Conservation Plan* was a stakeholder analysis that identified the individuals, groups and organizations that affect,

or are affected by, biodiversity conservation efforts. These stakeholders may consist of various interests, from government agencies or non-government organizations to local communities, landowners or corporate groups. An effective stakeholder analysis would identify the stakeholders that hold the most critical or urgent stakes in the conservation area, then defines the stakeholders' interests with respect to the selected conservation targets as well as the group's leverage held in associated strategies and relationship(s) to other stakeholders (Parrish, 2001). The *Conservation Plan* instead identified a few examples of completed studies that could lend input to this process for future iterations of the plan.

The plan identified a future stakeholder analysis to include elements that strengthen the Partnership's ability to implement conservation strategies and restoration efforts. Examples of these elements included:

- The identification of all critical stakeholders in the Sandhills landscape.
- A matrix that identifies the interests of a given stakeholder group with relation to a conservation target.
- The leverage and sources of power of a given stakeholder group with relation to a conservation target or strategy.
- Key assessments of a stakeholder group's bargaining strengths and limits.
- A stakeholder's contribution or ability to lessen the affects of a stress, or its relationship to the identified threats.

Conclusion

The adoption of the plan would mark the end of the first phase of the planning process. The Nature Conservancy stresses that “Conservation by Design” is an iterative process that requires consistent attention to updating, as well as adaptive to changing circumstances, needs and future knowledge. The implementation of conservation work is recognized as the most important aspect of the partnership’s work, however, and is part of the reason for a certain de-emphasis on placing too much time or too many resources on the planning and document phase of the project. The outcomes sought from the plan need to be effective at furthering the efforts at protecting biodiversity, implementing conservation on the land and building the institutional capacity of the partnership in the Sandhills.

CHAPTER 8: OUTCOMES SOUGHT FROM THE *SITE CONSERVATION PLAN FOR THE NC SANDHILLS*

Introduction

The Strategy Framework is the clearest outline of what outcomes the partnership seeks from the Site Conservation Plan for the NC Sandhills. In this section, I'll describe how these strategies relate to the three types of outcome that The Nature Conservancy describes in its Conservation by Design planning process, which are: threat abatement, restoration strategies and capacity building. Whereas threat abatement and restoration strategies are the traditional and, perhaps, more direct means for organizations such as The Nature Conservancy to reach its goals, I argue that capacity building may ultimately be the most effective (but difficult) way to create broad scale, institutional change that benefits its goals.

Threat Abatement

At first glance, threat abatement appears to be the primary thrust of the Strategy Framework. Three objectives (*see Objectives 6, 8 and 9 in Appendix A*) focus on reducing the impacts of pine straw raking, land use controls and golf course practices through best management practices and smart growth development principles. Objective 5 (*see Appendix A*) focuses on promotion of forestry best management practices and educating foresters on the economic benefits of sustainable forestry practices that also benefit longleaf pine ecosystems. Objective 7 (*see Appendix A*) outlines strategies to create communications networks with transportation officials and affect DOT decisions and

practices that reduce the impacts of state highways. Though these objectives and strategies all seek to reduce the impacts of incompatible land uses that threaten Sandhills biodiversity, the framework also integrates restoration strategies, primarily focused on implementing prescribed fire, throughout the ten objectives and includes a first, and perhaps primary, objective of land acquisition.

Restoration Strategies

Restoration strategies occur in two areas; first, in Objective 1, which focuses on sensitive lands protection, and second, throughout the Strategy Framework where strategies to implement prescribed fire are found. Objective 1 offers two strategies to protect sensitive lands. The first strategy for land protection is to do what The Nature Conservancy and Sandhills Area Land Trust are already doing, which is to acquire sensitive lands through fee simple or easement purchase, or land donations, and apply conservation measures, such as prescribed fire, timber thinning, red cockaded woodpecker habitat creation or tree planting. The other land protection measure is to facilitate or create more market based incentives for good land stewardship, such as the US Fish and Wildlife Service's Safe Harbor program. The Safe Harbor program has been successful in bringing about cooperation in land stewardship in exchange for lighter restrictions with wary landowners who have red cockaded woodpecker's nesting on their land and might be subject to the limitations of the Endangered Species Act. These two strategies may take up only a small portion of the Strategy Framework's space, but I would estimate them to be 90% of the partnership's focus on how to address Sandhills biodiversity planning.[9]

[9] This is an admittedly wild, unfounded estimate.

Strategies that address implementing prescribed fire are also integrated throughout the Strategy Framework. This is evidence of the partnership's view that much of the longleaf pine habitat degradation is occurring due to limitations that human land use has had on naturally occurring wildfires to maintain the ecosystem's structure. These strategies focus on a combination of threat abatement and capacity building as a means for easing these limitations for future maintenance of the Sandhills landscape through prescribed fire.

Capacity Building

The Strategy Framework lists four objectives that focus on capacity building. Two of these objectives (*see Objectives 4 and 10, Appendix A*) focus on increasing the resources and efficiency of the Sandhills Conservation Partnership. Suggested means to do so include; (1) developing the capacity for landowners and private individuals by offering training opportunities on how to do prescribed burning, both for personal and commercial reasons, (2) seeking new sources of funding for land acquisition and conservation work, and (3) developing networks between partnered organizations and sharing resources. One objective (*see Objective 3, Appendix A*) focuses on educating the public and local governments on the benefits, both economic and natural, of prescribed fire's application to longleaf pine, whereas another objective (*see Objective 2, Appendix A*) seeks to remove legal barriers to implementing prescribed fire. All of these objectives focus on strengthening the partnership's capacity for conservation work.

Though the partnership's strategies do well to outline necessary means for strengthening its own work, it does little to seek the broad involvement or backing of the public. When

facing regional land use dilemmas such as the one the partnership faces, there always seems to be a diversity of non-resource based economies, such as the real estate market, that have an interest in the conditions of the local environment, both built and natural. In the following section I'll provide my interpretation of what the many diverse stakeholders in the Sandhills might look like.

Stakeholder Matrix[10]

Emphasis on the diversity of stakeholders cannot be stressed enough when considering biodiversity planning in the face of growth and development in the Sandhills. The following table offers my categorization of a range of stakeholders who hold stakes in deciding how growth will take place in the Sandhills in years to come. Along with the stakeholder categories, the matrix outlines interests, resources to affect change and incentives for cooperating in regional growth management planning per each stakeholder.

[10] *(Represents)* delineates the actual Stakeholders represented by *Stakeholder*, *Interests* outlines a stakeholder's main interests in Sandhills land use planning, *Resources* lists the capabilities of a stakeholder to influence the planning process, *Incentives for Cooperation* outlines reasons for a stakeholder to get involved in cooperative regional planning efforts (Source: Sustainable Sandhills and Sustainable Fort Bragg, 2005).

Stakeholders	(Represents)	Interests	Resources	Incentives for Cooperation
Local Stakeholders:				
County Governments	Cumberland, Harnett, Hoke, Moore, Richmond, Scotland County	Protect homeowner rights, develop economic viability of respective county	Zoning, county ordinances and tax base	Depends how much they stand to lose from the JLUS Study recommendations - not participating reduces capabilities to protect interests in neighboring land uses, Hoke County is a special case (stands to lose the most)
City Governments	Fayetteville and 13 other towns?	Protect homeowner rights, develop economic viability	Zoning, city ordinances and tax base	Depends how much they stand to lose from the JLUS Study recommendations - not participating reduces capabilities to protect interests in neighboring land uses
Chambers of Commerce	Local business interests	Business climate, economic development, incentives	Organize business owners' interests, can raise funds for projects	Long term economic viability
Business Owners	As individual firms	Diverse individual interests, business climate, economic development, incentives	Various	Long term economic viability
Realtors Associations	Local real estate agents and agencies	Strong real estate market	Various	Maintain interest in purchasing land in the Sandhills
Home Builders Associations	Contractors, home builders and trades people	Strong home building market	Various	Protect interests from stringent regulations, maintain interest in purchasing homes in the Sandhills
Landowners	Sandhills landowners	The fullest extent of landowner rights and benefit land value	Vote	Protect land rights, protect character of the Sandhills

Residents	Individuals and community organizations	Protect homeowner rights, retain jobs, future regional viability, many others	Vote for local legislators, contribute $$ and sweat to favored organizations, litigation	Depends on where the residents live, where they are employed, the land use context of their homes, their length of residence in the area
Federal Agencies:				
Fort Bragg/Pope Air Force Base	US Army/Air Force	Maintain/increase training capabilities, comply with Federal laws	Comparably high levels of Federal funding, dependent local economy, ability to create institutional networks	Encroachment on borders and presence of RCW has reduced training capabilities, base closings around the country have sweetened Fort Bragg's willingness to cooperate
USFWS	US Fish and Wildlife Service	Recover the RCW	Endangered Species Act (1973), small budget, networking capabilities	Small budget and inability to produce results alone
State Agencies:				
DCA	NC Dept. of Commerce - Division of Community Assistance	Assist in community development	Small budget, networking capabilities, services offered to local communities	Organization's purpose
DENR	NC Dept. of Natural Resources	Management of State Parks	Budget, lands	Leverage capabilities

The ability to manage growth is as imperative to biodiversity protection as an effective fee simple and easement acquisition program. Fort Bragg has been a key factor for providing capital resources and helping to organize regional planning efforts, such as the Sustainable Sandhills Initiative and Regional Land Use Advisory Committee. In fact the perpetuation of Fort Bragg as viable training facility and, thus, an economic engine for Sandhills communities and support for conservation planning appears to be dependent on the ability to address growth management issues at a regional scale.

The partnership hopes that this science based, geographically specific conservation plan for the Sandhills can be incorporated into the wider breadth of regional planning that is performed by the Sustainable Sandhills Initiative. By educating local governments on the importance of the longleaf pine ecosystem to Fort Bragg and the local economy, the partnership hopes that the Site Conservation Plan for the NC Sandhills can affect the all too important zoning and local policy frameworks that have facilitated habitat degradation and residential encroachment on the installation.

Conclusion

I believe that an effective partnership, not only within the Sandhills Conservation Partnership but between the partnership and other planning organizations such as the Sustainable Sandhills Initiative and Regional Land Use Committee, is the most effective way for change to be made on a broad scale. However, the many stakeholders and diversity of interests make this a difficult proposition. The fact that leaders of the partnership, such as Pete Campbell with the US Fish and Wildlife Service and Rick

Studenmund of The Nature Conservancy, have taken leadership roles in many of the different working groups and other partnerships seems to be a great step towards bridging communication gaps and networking ideas between groups.

My interpretation and greatest critique of the Sandhills Conservation Partnership is that, despite a thorough Strategy Framework, it doesn't recognize the importance of an effective public awareness and participation campaign. I think the partnership could strengthen its capacity and support by educating the public on the threats current land use practices have on Fort Bragg and the longleaf ecosystem, the benefits these two entities have to local communities and the ways that local governments can work to address the issues. This could be done by newspaper editorials, volunteer workdays, public awareness booths at fairs or 4th of July parades, addressing local governments at town council or planning board meetings and any other opportunity to reach out to community members at a grassroots level. The partnership could benefit by involving more students from local high schools and nearby universities to perform volunteer work, as well as retirees who have sought the area for its natural beauty. Unfortunately, these suggestions take a good deal of time and effort, much of which is already stretched thin by the current work load of agency and partnership members. I don't have a suggestion for how the partnership should balance its workload, except to emphasize the importance of tapping the local pool of willing and available volunteers.

I also think there is a desire on the part of the partnership to integrate the latest technology and best possible strategies for developing a defensible, attainable and

publicly attractive conservation plan that can easily be integrated into local and other regional planning efforts. However, the means and time for exploring how to go about this is limited for the partners and will only occur when ideas are brought to them. In the following Discussion section, I'll explore some of the potential tools and techniques that seem to be changing the way biodiversity planning is taking place, the issues with trying to implement them and the directions biodiversity seems to be heading in. Ultimately, I think that advances in technology and scientific understanding of natural systems, coupled with grassroots education, planning and advocacy campaigns can help drive us towards a sustainable balance of land use in years to come.

CHAPTER 9: DISCUSSION

Introduction

In this chapter I explore two points of discussion that I find interesting from looking at the case study of the Site Conservation Plan for the NC Sandhills. First, I find the desire of the Sandhills Conservation Partnership to integrate its reserve design into a more comprehensive spatial analysis that takes into account threats and, potentially, urban growth models or similar statistical models an interesting point of discussion as to the utility or practicality of bridging gaps between landscape ecology and land use planning. Second, I investigate the potential ability for the partnership to integrate its conservation plan into a more comprehensive regional land use planning effort, such as the Sustainable Sandhills Initiative.

Spatial Analysis – A Golden Calf?

One of the future aims for the Sandhills conservation planning process is to develop a spatial analysis that will provide a more science-based, analytical framework to understand the area's land use and biodiversity. The goal is to link up the Reserve Design that was performed by the Reserve Design Working Group into an analysis of threats and future development trends. The potential exists to develop the spatial analysis into a decision support tool that could analyze the biodiversity value, potential threats, land use designation, or other factors of interest for a given parcel of land that is available for purchase or easement donation. The ability to do so could both streamline the efficiency of the partnership to preserving and leveraging the purchase of key lands, as well as lend

greater credence to the partnership's work in the eyes of public officials for raising money. I'm not sure that anyone in the Sandhills Conservation Partnership has a clear idea of how to go about this, or whether it is practical to do at all. In fact, despite the relatively recent development of geographic information systems (GIS) as an incredibly powerful analytical tool, it seems that few planners or land managers have been able to use it for purposes beyond mapping and basic comparisons of primary data.

The field of landscape ecology holds great promise for understanding the patterns and processes of natural phenomenon's response to human land use. Statistical models that use biological surrogates, such as soils, slope, and transformed-angle aspect (a factor of sun-angle to land), have been remarkably accurate at predicting vegetation and classifying communities in certain areas, which allows planners to view the spatial patterns of natural communities (see Urban, 2000). Other examples point to the utility of this type of analysis for land use planners: Webb and Thiha (2002) integrated biophysical data (slope, land use and accessibility) with social suitability and socioeconomic factors to determine the attractiveness of an area for plantation conversion in rural Myanmar. White, et. al. (1997) used remote sensing and future development scenarios in Monroe County, PA to determine that constrained patterns of development activity yielded more stable species richness numbers than those with changing zoning and development constraints. Dale, et. al. (1998) used GIS models to predict responses of land cover to impacts of human land use at the Oak Ridge Reserve in eastern Tennessee, and subsequent risk of degradation to spatially explicit natural communities. In Florida, Hoctor et. al. (1999) developed a decision support tool that uses land data and

information on ecologically significant areas to identify areas of priority and potential linkage for an aggressive, statewide land acquisition program called Greenways. Kautz and Cox (2001) used GIS to first develop habitat distribution maps of 179 rare taxa, then used public and private lands to develop a program to evaluate the cost of saving these species (at 15% of Florida's annual budget). Clearly, there is emerging potential for utilizing available data to better understand a planning area and evaluate alternatives.

However, the Sandhills case poses a few problems with doing so. First, there are few individuals with the time or expertise to develop and implement such a tool. Second, even if time were made available and individuals were trained, there are specific data elements that would render any such analysis incomplete (i.e., certain infrastructure such as sewer and power lines that have direct implications to development pressures and are now considered classified information, and community classifications such as upland depressional wetlands that are not well understood may be difficult to delineate). Third, even if data were complete and the capacity existed to do the analysis, it would require and amount of funding and long term commitment to continuous updating that is beyond the ability of the Sandhills Conservation Partnership to provide. Given the scope of the resources available, members of the partnership would likely rather devote such limited funds to acquisition and conservation work that produces more direct results. This problem has been recognized by conservation theorists, who cite land managers as viewing such approaches as prescriptive, expensive and unwieldy to those not specifically trained to implement them (Pendergast, Quinn and Lawton, 1998).

Still, I wouldn't advise the Sandhills Conservation Partnership to drop all plans to develop a spatial analysis tool. I think the partnership has a great deal of free or cheap analytical capacity that it could tap, considering the interest and nearby university resources that the area has attracted. Duke University's Nicholas School of the Environment has several faculty members and many a willing graduate student who, I would think, might eagerly take on a research topic with implications for direct application, as well as similar potential opportunities in departments at the University of North Carolina and North Carolina State University. Members of the partnership could provide research opportunities for students, if they were willing to commit enough time to guide these students on the specific needs of the partnership as the projects were implemented. As funding was raised for the development of the Site Conservation Plan for the NC Sandhills, it could similarly be done for the development of this analysis. If it were done, I think such an analysis could add immeasurably to the partnership's work by helping them understand and educate communities on the form and process of Sandhills biodiversity.

Comprehensive Regional Planning to Affect Local Land Use Policy

The Sandhills Conservation Partnership would like to see the Site Conservation Plan for the NC Sandhills somehow be a force for change in land use planning done at the local level, potentially through the Sustainable Sandhills Initiative. The partnership seeks to do so at the regional level, though, where municipal and county governments are most likely to be working together and potential exists for affecting more uniform change. There are some problems with incorporating conservation and biodiversity issues into local

planning (primarily a lack of interest), but the Sandhills, with such a regional planning initiative already underway, seems like an open opportunity for this to happen.

Press, Doak and Steinberg (1995) argue that local governments operate on the ideal scale for preserving biodiversity. Coordination between state and federal agencies with private landowners *through* local can be an effective way to broker acquisition deals to implement effective reserve designs. Furthermore, they argue, biologists should be concentrating more effort on effecting land use policies that affect biodiversity interests through local government. However, Cort (1996) argues that data on elements of biodiversity is not used enough at the local level. According to her survey, areas that use the data most are ones that have state requirements to incorporate state Natural Heritage program data into zoning or project decisions.

Given my limited land use planning experience, this doesn't surprise me. It seems that planning often seeks to address lands with important economic environmental value, such as agricultural lands or stream corridors that protect water supplies, but rarely is biological data considered an important factor in developing a sustainable land use plan. The exception to this is wetlands, which have become well enough established as important for many different purposes, both economic and biotic. To establish these values on other types of lands, conservation organizations and educators need to find ways to better incorporate ecological services into the local planning mechanism.

The ability for the partnership to affect local planning through the Sustainable Sandhills may meet with mixed results. Regional planning entities are anecdotally often cited as good in theory and ineffective in practice. The Sustainable Sandhills Initiative has gone from being largely a Fort Bragg run operation to an independent non-profit organization. This is promising, given that I've heard more than a few Sandhills planners and land managers wonder aloud whether the organization would ever find the funding or momentum to continue. Given that a few members of the partnership have a defined role in the Sustainable Sandhills Initiative, there is reason to believe that they will be able to play an effective role in the organization's planning process. Furthermore, the results of the Joint Land Use Study may be an indication of some Sandhills local governments' willingness to accept the policy advice of regional planning. As of Fall 2004, 10 of 13 local governments had adopted the policy recommendations of the Joint Land Use Study. A few did not, but I think the fact that a regional process has already taken place and given local governments a relatively positive experience will make them somewhat more receptive to future efforts of a similar vein.

Regardless of certain limitations to regional planning or spatial analysis, I believe the partnership is doing the right in trying to implement them. After all, the Site Conservation Plan for the NC Sandhills calls for an "adaptive, iterative" process, and I believe that for the partnership to branch out beyond a program that is purely acquisition and conservation work oriented can only improve the capacity and effectiveness of its work.

CONCLUSION

With consideration to best practices and the field on conservation planning, the Site Conservation Plan for the NC Sandhills has a number of strengths, and a few weaknesses. First of all, I think the most important thing to keep in mind is the timing and scale of the plan's first iteration. Completed on a budget of less than $10,000, based on two workshops and a moderately completed "rapid assessment" in 2000, the plan is a solid foundation on which to build a planning process. It has all the necessary components that are called for from the Nature Conservancy's Conservation by Design framework. The framework was built on the input of a diverse set of highly knowledgeable, skilled professionals who understand the system they are planning for as well as anyone else. I also don't see the lack of spatial analysis (aside from the reserve design and gap analysis already completed) as a point of weakness, should it never come to fruition.

That said, distinctly missing is a clear program for monitoring the plan's success and a stakeholder analysis that could be used for outreach and bargaining purposes when the time comes to make the plan more public. I could argue that there are inherent biases in basing a course of action on one small group of individual's impressions of a landscape of biotic patterns and processes that few, if any, understand well (but I won't). I also wonder how the plan will be used within the partnership. I don't see it as a great outreach tool in and of itself, nor do I see it guiding the actions of partnership members.

I think it's fair to say that the strengths and weaknesses of the planning effort are emblematic of those that adhere to conservation planning in general. Perhaps often times it can be said the process is the more important than the resulting plan. In the case of the Sandhills effort, it forced the partnership to focus on the future efforts of the organization and brought the partnership's leaders together to view this future under a similar framework. It deepened the network of the partnership and forced the organization to seek new strategies to strengthen its work. It may have educated some members to perspectives and interests of differing organizations. The plan, as a document, also legitimizes the partnership's actions. When completed and adopted, the plan is a statement of the partnership's willingness to commit to working in the Sandhills and a way for even competing interests to better understand its work. The true test, as with any plan, will be in the commitment of the partnership to follow through and implement the plan, adapting to necessary changes as time goes on. The success of the plan and the partnership will rest ultimately in the utility and enjoyment of longleaf pine, red cockaded woodpeckers and clean blackwater streams for Sandhills residents in years to come.

GLOSSARY OF TERMS

Biodiversity – natural variety and variability among living organisms, the ecological complexes in which they naturally occur, and the ways in which they interact with one another and the physical environment. (Redford and Richter, 1999)

Composition – identity and variety of elements in each of biodiversity components (Redford and Richter, 1999)

Conservation – consumptive and non-consumptive use (of a resource) without complete destruction/conversion (Redford and Richter, 1999)

Ecosystem – A dynamic and interrelating complex of plant and animal communities and their associated nonliving (such as physical and chemical) environment (USFWS, 2004)

Function – ecological and evolutionary processes interacting amongst biodiversity elements (Redford and Richter, 1999)

Habitat – The place or environment where a plant or animal naturally lives and grows (a group of particular environmental conditions) (USFWS, 2004)

Preservation – non-use (of a resource) (Redford and Richter, 1999)

Species – For purposes of the Endangered Species Act, this term includes any species or subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature (USFWS, 2004)

Structure – physical organization or pattern of biodiversity elements (Redford and Richter, 1999)

Threatened species – An animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range (USFWS, 2004)

REFERENCES

Babbit, B. 1999. Diversity: Noah's Mandate and the Birth of Urban Bioplanning. *Conservation Biology*. 13 (3): 677-678

Beatley, T. DATE. Preserving Biodiversity. *Journal of the American Planning Association*. Winter, 66(1)

Benedict, M and E. McMahon. 2001. Green Infrastructure: Smart Conservation for the 21st Century. The Conservation Fund – Sprawl Watch Clearinghouse. Washington, D.C.

Cort, C. 1996. A Survey of the Use of Natural Heritage Data in Local Land Use Planning. *Conservation Biology*. Blackwell Science, Inc. 10(2) 632-637

Dale, V., A. King, L. Mann, R. Washington-Allen and R. McCord. 1998. Assessing Land-Use Impacts on Natural Resources. *Environmental Management*. Springer-Verlag New York Inc., NY. 22(2), 203-211

Daily, L. 1988. Tropical Forests and You. *American Forests*. Nov/Dec.

Daniels, T. and K. Daniels. 2003. Planning for Wildlife Habitat. Chapter 9 in *The Environmental Planning Handbook: for Sustainable Communities and Regions*. American Planning Association. Chicago, IL.

East Contra Costa County Habitat Conservation Plan Association. 2005. East Contra Costa County Habitat Conservation Plan. East Contra Costa County Habitat Conservation Plan Association. Downloaded on March 18, 2005 from http://www.cocohcp.org/index.html.

Ehrenveld, D. 1976. *The Conservation of Non-Resources*. American Scientist. Nov/Dec

Ewing, R., J. Kostyack, D. Chen, B. Stein, M. Ernst. 2005. *Endangered by Sprawl: How Runaway Development Threatens Ameirca's Wildlife.* National Wildlife Federation, Smart Growth America, and NatureServe. Washington D.C.

Funders Network for Smart Growth and Livable Communities. 2002. *Biodiversity and Smarth Growth: Sprawl Threatens Our Natural Heritage.* Collins Center for Public Policy, Inc. Miami, FL.

Groves, C., L. Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval, B. Runnels. 2000. Designing a Geography of Hope: A Practitioner's Guidebook for Ecoregional Conservation Planning. The Nature Conservancy. Washington, D.C.

Harding, E., E. Crone, B. Elderd, J. Hoekstra, A. McKerrow, J. Perrine, J. Regetz, L.

Rissler, A. Stanley, E. Walters, NCEAS Habitat Working Group. 2001. The Scientific Foundations of Habitat Conservation Plans: A Quantitative Assessment. Conservation Biology. 15 (2): 488-500

Hall, S. and Schafale, M. 1991. Conservation Assessment of the Southeast Coastal Plain of North Carolina Using Site-Oriented and Landscape-Oriented Analyses. North Carolina Natural Heritage Program. Raleigh, NC.

Hoctor, T., M. Carr and P. Zwick. 2000. Identifying a Linked Reserve System Using a Regional Landscape Approach: The Florida Ecological Network. *Conservation Biology*. Blackwell Science, Inc. 14(4) 984-1000

Kautz, R. and J. Cox. 2001. Strategic Habitats for Biodiversity Conservation in Florida. Conservation Biology. Blackwell Science, Inc. 15(1) 55-77

Lassila, K. 1999. *The new suburbanites: how American plants and animals are threatened by the sprawl*. The Amicus Journal. 21 (i2): 16-22

Leopold, A. 1949. The Land Ethic. In *A Sand County Almanac*. Oxford University Press. Oxford.

Maryland Department of Natural Resources. 2003. Maryland Greenprint Program. Maryland Department of Natural Resources. Downloaded on March 18, 2005 from http://www.dnr.state.md.us/greenways/greenprint/.

Millennium Ecosystem Assessment. 2005. Millennium Ecosystem Assessment Synthesis Report. Millenium Assessment Board. Pre-publication final draft – March 23, 2005.

Miller, K.R. and S.M. Lanou. 1995. *National Biodiversity Planning: Guidelines Based on Early Experiences Around the World*. World Resources Institue, United Nations Environment Programme and The World Conservation Union. Washington D.C.

Muir, J. 1894. *The Mountains of California*. The Modern Library (pub. 2001). New York, NY.

Muir, J. 1897. The American Forests. In *Nature Writings* (pub. 1997). The American Library. New York, NY. Pp. 701-720.

Nabhan, G. 1995. *Dangers of Reductionism*. Conservation Biology. 9(3): 479-481

Nelson, L. 2004. *Site Conservation Plan for the NC Sandhills*. Sandhills Conservation Partnership. Southern Pines, NC.

North Carolina Sandhills Conservation Partnership Communications Working Group.

2004. *Draft Communications Plan.* North Carolina Sandhills Conservation Partnership. Unpublished.

Noss, R., M. O'Connell & D. Murphy. 1997. The Science of Conservation Planning: Habitat conservation under the Endangered Species Act. Washington, DC: Island Press

The Nature Conervancy. 2004. *Site Conservation Plan for the NC Sandhills.* Sandhills Conservation Partnership. Southern Pines, NC. 83 pp., plus appendices.

Parrish, J. 2001. Recommended Template for Written Site Conservation Plans: Version 1.0. The Nature Conservancy – International Site Conservation Program. Arlington, VA.

Prendergast, J., R. Quinn and J. Lawton. 1999. The Gaps Between Theory and Practice in Selecting Nature Reserves. *Conservation Biology*. Blackwell Science, Inc. 13(3) 484-492

Press, D., D. Doak and P. Steinberg. 1996. The Role of Local Government in Preserving Rare Species. *Conservation Biology*. Blackwell Science, Inc. 10(6) 1538-1548

Primack, R. 1993. Essentials of Conservation Biology. Sinauer Associates, Inc. Sunderland, MA

Redford, K. and B. Richter. 1999. Conservation of Biodiversity in a World of Use. *Conservation Biology*. 13 (6): 1246-1256.

Sandhills Conservation Partnership. 2004. Notes from the meeting of the Reserve Design Working Group. November 14, 2004. Unpublished.

Schafale, Michael (Community Ecologist, North Carolina Natural Heritage Program) and Rick Studenmund (Director, The Nature Conservancy Sandhills Project). Personal communication on 6/14/04).

Schafale, M. 1994. Inventory of the Longleaf Pine Natural Communities in North Carolina, North Carolina Natural Heritage Program. Raleigh, NC.

Sorrie, B. North Carolina Natural Heritage Biologist, personal communication on 8/15/04.

Sustainable Sandhills. 2005. Website to the non-profit Sustainable Sandhills Initiative. Cited on 4/1/05 from http://www.sustainablesandhills.org/index.html.

Threatened and Endangered Species System. 2005. Listings by State and Territory as of 3/17/05. US Fish and Wildlife Service. Downloaded on March 17, 2005 from http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state=all.

Tuan, Y. 1977. *Space and Place: The Perspective of Experience*. University of Minnesota Press. Minneapolis, MN.

Tuan, Y. 1986. *The Good Life*. The University of Wisconsin Press. Madison, WI.

Tuan, Y. 1998. *Escapism*. Johns Hopkins University Press. London.

Urban, E. 2000. Forest gradient response in Sierran landscapes: the physical template. *Landscape Ecology*. Kluwar Academic Publishers, Netherlands. 15: 603-620.

US Census Bureau. 2004. United States, Regions, States and Puerto Rico Population Estimates and Population Change. US Census Bureau Embargoed News. Downloaded on March 17, 2005 from http://www.census.gov/Press-Release/www/releases/archives/CB04-246.pdf.

US Fish and Wildlife Service. *2003.* Recovery plan for the red cockaded woodpecker (*Picoides borealis*): second revision. US Fish and Wildlife Service, Altanta, GA. 296 pp.

US Fish and Wildlife Service. 2004. Endangered Species Glossary. Downloaded on March 17, 2005 from http://endangered.fws.gov/glossary.pdf.

Webb, E. and Thiha. 2002. Integrating Social Preference in GIS-Aided Planning for Forestry and Conservation Activities: A Case Study from Rural SE Asia. *Environmental Management.* Springer-Verlag, NY. 30:2 183-198

White, D., P. Minotti, M. Barczak, J. Sifneos, K. Freemark, M. Santelmann, C. Steinitz, A. Keister, E. Preston. 1997. Asessing Risks to Biodiversity from Future Landscape Change. Conservation Biology. Blackwell Science, Inc. 11:2 349-360.

Wilson, E.O. 1993. Biophilia and the Conservation Ethic. Chapter 1 in *The Biophilia Hypothesis*. Island Press. Washington, D.C.

Appendix

STRATEGY FRAMEWORK

Objective 1 – To protect critical conservation lands

- Strategy 1.1 – Purchase lands or easements that protect unique natural values and/or connect, buffer or expand existing conservation lands
- Strategy 1.2 – Encourage and provide incentives to restore degraded natural communities through cost share and other incentive programs, such as Safe Harbor

Objective 2 – To eliminate legal obstructions to prescribed fire

- Strategy 2.1 – Affect North Carolina Department of Environment and Natural Resources rules on air quality regulation interpretation

Objective 3 – To educate the public and decision makers about the benefits of prescribed fire

- Strategy 3.1 – Implement fire outreach and awareness programs, such as demonstrations of professional fire management

Objective 4 – To increase resources (personnel, training, equipment, funding, etc.) to private and public land managers for prescribed fire

- Strategy 4.1 – Establish a "North Carolina Fire Council"
- Strategy 4.2 – Identify outside sources of funding for prescribed fire on Partnership lands
- Strategy 4.3 – Increase the ability of fire management entities to collaborate and cross boundaries through formal agreements
- Strategy 4.4 – Seek additional State and/or Federal funding for the application of prescribed fire on private lands
- Strategy 4.5 – Increase the number of private qualified landowners and contractors to burn on private lands
- Strategy 4.6 – Make available and promote training opportunities to private landowners and contractors in government and non-profit fire courses
- Strategy 4.7 – Work with North Carolina Forest Service to increase internal funding for prescribed fire on private lands
- Strategy 4.8 – Work with the North Carolina Forest Service to implement the Fire Wise program in the Sandhills

Objective 5 – To encourage forestry practices that maintain and/or restore longleaf pine communities

- Strategy 5.1 – Bolster existing and create new incentive programs for natural forest stewardship
- Strategy 5.2 – Educate the public and foresters about the economic benefits of longleaf pine and importance of healthy groundcover

- Strategy 5.3 – Encourage reforestation practices that don't diminish the wiregrass groundcover
- Strategy 5.4 – Review Best Management Practices and propose changes based on the most recent sustainable forestry research
- Strategy 5.5 – Promote prescribed fire as an alternative to herbicide use for hardwood control in existing forest stands
- Strategy 5.6 – Promote the use of prescribed fire to minimize ground disturbance for site preparation of new forest stands

Objective 6 – To lessen the impacts of pine straw raking on forest health, including groundcover

- Strategy 6.1 – Review literature and impacts of pine straw raking and fertilizer application in longleaf pine
- Strategy 6.2 – Encourage pine straw harvesting on plantations instead of natural forests
- Strategy 6.3 – Working with pine straw producers, create Best Management Practices in natural forests (i.e., hand raking versus mechanical raking, fire rotation, etc.)

Objective 7 – To improve the design, construction and maintenance of roads for environmental compatibility

- Strategy 7.1 – Establish working relationships with North Carolina Department of Transportation (DOT) district engineers
- Strategy 7.2 – Encourage the DOT to use existing right-of-ways over new routes
- Strategy 7.3 – Provide DOT with information about sensitive natural resources in time to influence planning and siting of roads and road expansions
- Strategy 7.4 – Prevent the planting of invasive species by DOT along roadsides and expand the use of native species, where appropriate
- Strategy 7.5 – Improve the implementation of roadside management for rare species

Objective 8 – To implement land use controls that are environmentally sustainable

- Strategy 8.1 – Educate decision makers and the public about the value of open space and incentives that exist to maintain it
- Strategy 8.2 – Encourage local strategies to preserve open space through tools such as tax abatement, local trust funds, etc.
- Strategy 8.3 – Encourage the adoption of sustainable county or local land use plans
- Strategy 8.4 – Encourage the preservation of new and existing natural riparian buffers
- Strategy 8.5 – Develop relationships with equestrian community to encourage the design and management of horse farms compatible with Red Cockaded Woodpeckers and adjacent natural areas
- Strategy 8.6 – Encourage the incorporation of Smart Growth principles and practices in local and county land use planning

Objective 9 – To minimize the impacts of golf course development and management

- Strategy 9.1 – Ensure the application of new Red Cockaded Woodpecker guidelines and encourage clustered design in the development of golf courses
- Strategy 9.2 – Establish relationships with golf course managers to affect changes I management, such as water use, herbicides, etc.

Objective 10 – To build a stronger, more effective partnership through communication, coordination and sharing of resources

- Strategy 10.1 – Build the capacity of individual partners and their commitment to the mission of the NC Sandhills Conservation Partnership
- Strategy 10.2 – Attract additional partners to the NC Sandhills Conservation Partnership with common interests and available resources
- Strategy 10.3 – Train and coordinate the use of volunteers between agencies and non-profits